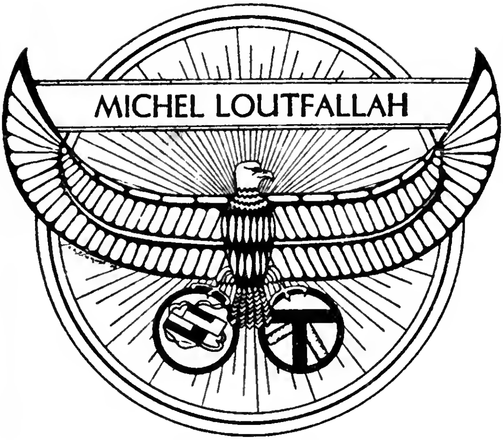

MICHEL LOUTFALLAH

THE

DISEASES OF THE EYE

THEIR

MEDICAL AND SURGICAL TREATMENT.

BY

J. H. BUFFUM, M.D., O. et. A. Chir.,

PROFESSOR OF OPHTHALMOLOGY AND OTOLOGY IN THE CHICAGO HOMŒOPATHIC MEDICAL COLLEGE; OPHTHALMIC SURGEON TO THE CENTRAL DISPENSARY; FORMERLY RESIDENT SURGEON OF THE NEW YORK OPHTHALMIC HOSPITAL; MEMBER OF THE AMERICAN INSTITUTE OF HOMŒOPATHY; MEMBER OF THE AMERICAN HOMŒOPATHIC OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY, ETC., ETC.

ONE HUNDRED AND FIFTY WOOD ENGRAVINGS AND TWENTY-FIVE COLORED LITHOGRAPHS.

CHICAGO:
GROSS AND DELBRIDGE.
1884.

R. R. McCabe & Co., Printers, Chicago.

TO

TIMOTHY F. ALLEN, A.M., M.D.,

PROFESSOR OF MATERIA MEDICA AND THERAPEUTICS IN THE NEW YORK
HOMŒOPATHIC MEDICAL COLLEGE,

THIS BOOK

IS DEDICATED,

In grateful recognition of his masterly teachings, of his valuable contributions
to Medical Science and Ophthalmic Therapeutics, and in
remembrance of many acts of kindness.

PREFACE.

In the preparation of this work it has been the design of the Author to state as concisely and briefly as possible the present views of ophthalmic science. The endeavor has been to make the work practical and at the same time as thorough as the importance of the subject demands. The causes, symptoms, differential diagnosis, and treatment of those diseases which are more commonly met with in general practice have been fully considered. The methods of treatment described are those which have borne the test of hospital and private practice, and in the experience of the writer have been found of value.

Numerous illustrations have been introduced to better elucidate the conditions and operations described, and such as are not original have been selected from the standard works on ophthalmology, as well illustrating the points presented. Colored lithographs from the admirable atlas of Sichel and others have been added in the endeavor to more fully depict the diseases described and thus enable the student or practitioner to readily diagnose the various affections when presented.

The brevity of the book has prevented reference in the body of the work to the authorities consulted in its preparation, and a list has been appended.

A sheet of test types after the models of Snellen is furnished for the purpose of testing and recording the condition of the vision of patients.

I desire to express my thanks to Dr. C. F. Bassett for assistance rendered in the preparation of the Index and the reading of proof.

90 Washington Street.

CHICAGO, SEPTEMBER, 1883.

CONTENTS.

CHAPTER I.

GENERAL ANATOMY AND PHYSIOLOGY OF THE EYE.

CHAPTER II.

METHODS OF EXAMINATION.

CHAPTER III.

GENERAL CONSIDERATIONS OF TREATMENT.

CHAPTER IV.

WOUNDS AND INJURIES OF THE EYE.

CHAPTER V.

ERRORS OF REFRACTION.

CHAPTER VI.

AFFECTIONS OF THE MUSCLES.

CHAPTER VII.

DISEASES OF THE ORBIT.

CHAPTER VIII.

DISEASES OF THE LACHRYMAL APPARATUS.

CHAPTER IX.

DISEASES OF THE LIDS.

CHAPTER X.

DISEASES OF THE CONJUNCTIVA.

CHAPTER XVI.

DISEASES OF THE LENS.

CHAPTER XVII

DISEASES OF THE VITREOUS.

CHAPTER XVIII

DISEASES OF THE CHOROID.

CHAPTER XIX.

GLAUCOMA.

CHAPTER XX.

DISEASES OF THE RETINA.

CHAPTER XXI.

DISEASES OF THE OPTIC NERVE.

ILLUSTRATIONS.

BIBLIOGRAPHY.

Graefe and Saemisch: Handbuch der gesammten Augenheilkunde.
Stellwag: Treatise on Diseases of the Eye.
Soelberg Wells: Treatise on Diseases of the Eye.
Schweigger: Handbuch der Augenheilkunde.
Carter: On the Eye.
Macnamara: Diseases of the Eye.
Nettleship: Diseases of the Eye.
Donders: Accommodation and Refraction.
Alt: The Human Eye.
Mittendorf: Diseases of the Eye and Ear.
Gowers: Medical Ophthalmoscopy.
DeWecker: Ocular Therapeutics.
Albutt: The Ophthalmoscope.
Galezowski: Traite des Maladies des Yeux.
Landolt: Examination of the Eyes.
Noyes: Diseases of the Eye.
Knapp: Archives of Ophthalmology.
Royal London Ophthalmic Hospital Reports.
Norton: Ophthalmic Therapeutics.
Many smaller works, Monographs and Journals.

DISEASES AND INJURIES OF THE EYE.

CHAPTER I.

GENERAL ANATOMY AND PHYSIOLOGY.

To comprehend the various changes which result from disease or injury to the eye, a full knowledge of the anatomy and physiology of this organ becomes necessary. Without it, a proper appreciation of the value of the pathological changes which may result, in either a medical or surgical sense, is impossible. Hence, a review of the general anatomy of the eye, at this time, will be followed by a more detailed description of the histology of the separate portions in the various chapters, according to their importance.

ANATOMY.

The human organ of vision consists essentially of a hollow sphere into which the light vibrations are conducted through its anterior transparent portion and its refractive media, to fall upon the percipient elements in the expansion of the optic nerve upon the interior. For visual perception the eyeball with its contents alone is necessary; but connected with it are muscles, nerves, blood-vessels, and other parts especially designed for its nutrition and protection. The eyeball is suspended in the pyramidal cavity of the orbit at an equal

distance from its walls, and rests upon a cushion of loose fat and connective tissue, from which it is separated by a fibrous expansion—the capsule of Tenon. It is freely movable in every direction about its center of rotation in this membranous socket by the muscles inserted into its outer coat.

Through its capsule, its vascular and lymph supply, and the optic nerve, it is in direct communication with the brain and its membranes. It is thoroughly protected from external injury by the strong, bony margin of the orbit, the eyelids and their cilia and the delicate mucous membrane covering it externally. This membrane is also reflected upon the eyelids, forming a soft and moist membrane, necessary to preserve the transparency of the anterior part of the globe. This membrane, the *conjunctiva*, is continuous through the lachrymal canals with that of the nasal cavities, and with the integument of the face at the margin of the eyelids. Its moisture is derived from the secretions of its own glands and also from the *lachrymal gland* which is lodged in the upper and outer angle of the orbit, and sends numerous ducts to open upon the internal surface of the outer part of the upper lid. The conjoined secretions, after passing over the conjunctiva, are received by the two *puncta lachrymalia* at the inner canthus, or angle of the lid, which open into minute horizontal canals, the *canaliculi*. These carry the tears to the lachrymal sac, from which they pass directly to the nose through the *lachrymal* and *nasal ducts*.

The eyeball, while presenting a globular or spherical form, is really formed by the union of portions of two hollow spheres of different diameter, of which the anterior and more prominent segment is the smaller; the segment of the larger opaque surface corresponds with the limit of the sclerotic portion, and the translucent portion of the smaller sphere with that of the cornea. The *antero-posterior diameter*, or axis of the eyeball is a line drawn perpendicularly through the centre of the cornea to the sclerotic, and measures about .95 of an inch, or 24.3 mm. in length. Its *transverse diameter* is a horizontal line drawn perpendicular to its axis at the centre of the eyeball

and measures .93 of an inch, or 23.6 mm. The *vertical diameter* is a line drawn at right angles to both these lines at the centre, and gives a length of .92 of an inch, or 23.4 mm. The *anterior pole* of the eye is the geometric centre of the

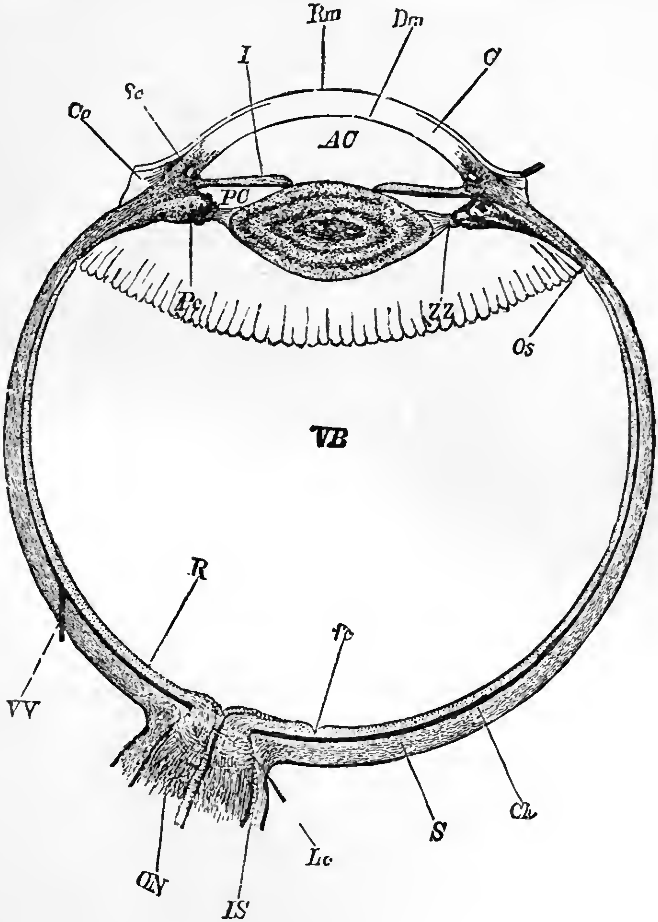


FIG. 1.

cornea, the *posterior pole* being the centre of the back part of the globe. The *optic axis* is the line connecting these two points. The *visual axis* is an imaginary line drawn from the object looked at to the macula lutea, the visual centre of the retina, and cuts the cornea slightly above and to the inner side

of the optic axis. The *equator* is the circle passing around the eye midway between the two poles. The *meridians* of the eye are circles formed by planes passing through the centre of the eyeball, the two principal meridians being the horizontal and the vertical.

The eyeball is composed of several investing tunics, enclosing fluid and solid contents, called the refracting media. The tunics, or investing membranes, are three in number, viz: an external fibrous membrane forming the Cornea (*C* Fig. 1) and Sclera (*S*); a middle vascular and partly muscular membrane, the Choroid (*Ch*) Ciliary body (*Pc*) and Iris (*I*), and an internal nervous stroma, the Retina (*R*). The enclosed refracting media are the Aqueous humor (*Ac*), the Lens (*L*), and Vitreous (*VB*), the most important being the crystalline lens, which is a double convex body enclosed in a transparent capsule and situated immediately behind the pupil. It is retained in position by a suspensory ligament, the zonule of Zinn (*ZZ*), which connects its periphery with the anterior margin of the retina and the ciliary processes. The space between the anterior portion of the lens and the posterior surface of the cornea is filled with the aqueous humor and is divided by a movable partition, the iris, into the *anterior* (*Ac*) and *posterior* (*Pc*) *chambers*. The Vitreous (*VB*) which occupies about four-fifths of the eyeball posteriorly, fills the cavity behind the lens and consists of an albuminous fluid inclosed in a delicate membrane, the hyaloidea.

The *Sclerotic* (*S* Fig. 1), having a thickness of nearly 1-25 of an inch or from .7 to .9 mm. is a strong, opaque, unyielding, fibrous structure which maintains the form of the eye and gives support to the delicate interior structures, and allows of the entrance and exit of nerves and blood-vessels which supply the parts within. It extends over about five-sixths of the eyeball, joining in front with the cornea. The outer surface is white and smooth except where the tendons of the recti and oblique muscles are inserted into it. About 1–10 of an inch to the inner or nasal side of the posterior pole of the globe, is an opening, partially closed by a sieve-like membrane, the

lamina cribrosa (*Lc*), 1–13 of an inch or 2 mm. in diameter, for the entrance of the fibres of the optic nerve (*ON*). The sclera is thickest behind; thinnest about 1–4 of an inch or 6 mm. from the cornea and thicker again at its junction with the latter. Its blood supply is very slight, and derived from the ciliary vessels. It is largely deficient in nerves.

The *Cornea* (*C*) forms the anterior one-sixth of the external coat, and presents a thickness of about 1-28 of an inch, or .9 mm. at its apex, and 1-22 of an inch, or 1.2 mm. at its margin.

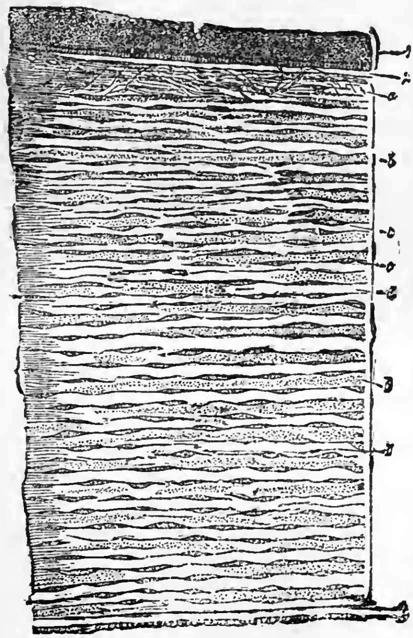


FIG. 2.

It is a perfectly transparent, highly polished membrane, and having a shorter radius projects from the sclera, and admits the light to the interior of the eye. It presents an ellipsoidal shape, having its horizontal diameter rather longer than the vertical, owing to the overlapping of the sclera, of which it is a modified continuation. It consists of five layers (Fig. 2): an outer layer of epithelium (1) continuous with the conjunctiva, a thin structureless membrane (2), a thicker central layer or true corneal tissue (3), a posterior elastic membrane (4), and upon the latter a layer of endothelium (5). The cornea has no blood-vessels except at its margin, and is nourished by endosmosis from these capillary vessels. Its nerve supply is very abundant and is derived from the ciliary nerves.

The *Canal of Schlemm* (*Sc* Fig. 1) is a circular venous sinus which surrounds the anterior portion of the eye. It is situated in the sclerotic, close to its junction with the cornea. A minute open space has been traced from it into the anterior

chamber (*AC*) from which it is separated by the ligamentum pectinatum. It forms the exit from the anterior chamber of the aqueous fluid which is derived from the vessels of the iris and ciliary processes. Upon the patency of this canal depends the condition of the intra-ocular tension.

The *Choroid* (*Ch* Figs. 1 and 3) is a dark, brown membrane 1-300 to 1-150 of an inch in thickness, lying between the sclera and the retina. It consists almost entirely of blood-vessels united by a delicate connective tissue, and forms the nutrient membrane for the lens and vitreous. It is loosely attached to the sclera, except where the optic nerve is transmitted, and reaches forward nearly to the cornea, where it ends in a series of folds or plaits, seventy in number, called the ciliary processes, where it again becomes more firmly attached to the sclera. In the choroid, four layers are described. Externally and resting upon the inner surface of the sclera, is a loose connective tissue containing branching black and brown pigment cells surrounding the vessels and nerves which pass from behind forward to supply the iris and ciliary body. Owing to its loose attachment to the sclera, a minute space (*Pch* Fig.3) is left which is lined by endothelium and forms a lymph space, which connects with Tenon's space about the exit of the veins of the choroid where they pierce the sclera. The second layer consists of larger branches of the ciliary arteries and whorl-like veins, the venæ vorticosæ (*VV* Fig. 1), which, passing deeper and becoming smaller, form the third layer, or layer of capillary vessels. The fourth layer consists of a minute structureless limiting membrane which gives the smooth inner surface to the choroid, and is covered by the hexagonal pigment cells of the retina.

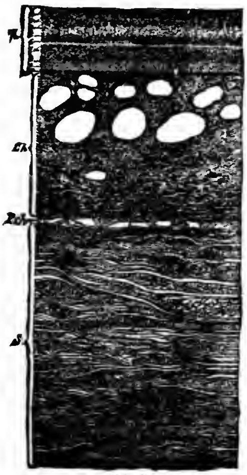


FIG. 3.

The *Ciliary processes* (*Pc* Fig. 1), about seventy in number,

are formed by the folding of that portion of the choroid which lies anterior to the equator of the globe, the pigment layer of the retina being continued forward as a covering. These processes are arranged radially together in the form of a circle. They consist of larger and smaller folds, without regular alternations, the small folds being in number about one third that of the larger. Into these folds of the ciliary processes, fit corresponding plications of the suspensory ligament of the lens.

The *Ciliary muscle*, the muscle of accommodation, is a circular band of involuntary muscular fibres which take both a circular and meridional course. This muscle underlies the ciliary processes and they together form the *Ciliary body.* The fibres of the ciliary muscle arise from a tendinous ring at the inner side of the canal of Schlemm. The meridional fibres pass backward and are lost in the tissue of the choroid, while the circular fibres form a sphincter or ring muscle. The ciliary body is largely supplied with vessels and nerves.

The *Iris* (*I* Fig. 1) is the contractile and colored membrane, which is seen behind the transparent cornea and gives the tint to the eye. It is a movable muscular curtain, with a central perforation, the pupil, which regulates the amount of light admitted to the eye. The iris measures about one-half an inch across, and in a state of rest about one-fifth of an inch from the circumference to the pupil. The iris consists of a loose stroma of connective tissue, containing muscular fibres, blood vessels, nerves and pigment cells, and may be regarded as a process of the choroid, with which it is continuous. The pigment layer of the retina is continued forward upon the posterior surface of the iris. Immediately beneath this are muscular fibres of the iris which take a radial course at the periphery, the dilator of the pupil, while at the pupillary margin are seen the circular fibres of the sphincter muscle of the pupil. The blood supply is derived from the ciliary body, the nerves coming from the third, fifth, and sympathetic. The anterior surface is variously colored in different eyes, and is marked by waved lines converging towards the pupil, while

at the pupillary margin, the surface is drawn into minute concentric folds. The anterior surface is covered by irregular endothelial cells continuous with those of the posterior layer of the cornea.

The *Retina* (*R* Figs. 1 and 3) is the delicate transparent expansion of the optic nerve, extending as far forward as the ciliary processes, where it terminates by an irregular margin, the *Ora Serrata* (*OS*). From this border a thin layer of laminated cells is continued with the pigment layer forward on to the ciliary processes, and forms the ciliary portion of the retina. It lies within the choroid and rests upon the hyaloid membrane of the vitreous. The thickness of the retina diminishes from behind forwards, varying from 1-50 to 1-200 of an inch. It is made up of some ten layers, four of which may be considered of importance. The most external layer is that of the hexagonal pigment cells upon the surface of the choroid; arranged vertically upon this is a layer of rods and cones which cover the expansion of the retina, being more closely aggregated at the *macula lutea* which has in its centre a depression or the *fovea centralis* (*Fc* Fig. 1) where only cones are found. The rod and cone layer presents a delicate coloring matter, the retinal purple, which is formed by the pigment layer. The internal layer of the retina consists of the expansion of radial fibres of the optic nerve, the larger portion of the fibres sweeping towards the temporal side about the macula lutea. Between these external and internal layers are the remaining layers, consisting of ganglionic cells, granules and fibres which connect the percipient elements with the conducting filaments. The blood supply of the retina is mainly from the central artery of the nerve, the most external layers being nourished by osmosis from the choroid.

The *Optic nerve* (*ON* Fig. 1) arises in the brain from two roots having their origin in the gray matter of the occipital lobes, intimately connected with the corpora geniculata, optici thalami and corpora quadrigemina, which receive fibres from other portions of the brain and spinal cord, and run forward as the optic tracts until they unite to form the optic chiasma,

in which they decussate and turn off to either side, each tract sending fibres to supply the inner half of the opposite eye, the greater portion, however, passing directly to the outer half of the retina of the same side. Some fibres have also been traced as passing from one eye to the other. The optic nerves proper as they emerge from the optic foramina are covered by a delicate neurilemma which is continuous with the pia mater and forms the pial sheath. More externally is a dense fibrous sheath continuous with the dura mater. These sheaths are joined together by a loose connective tissue and form a lymph space, the inter-vaginal, extending up to the sclera, which is in direct connection with the arachnoidal space of the brain. The nerve in the orbit is about one and one-eighth inches long and passes forward to enter the eye through the scleral ring, a little below and to the inner or nasal side of the posterior pole of the ball. It is made up of a large number of bundles of medullated fibres, which as they pass through the perforated opening in the sclera, leave their sheaths behind and radiate from the disc in all directions. The *optic disc* or *papilla* is the point of entrance of the optic nerve. The central artery of the retina (*e* Fig. 5) enters the nerve fifteen to twenty mm. behind the eyeball, and passing to the center of the nerve runs forward to appear upon the disc (Fig. 6), where it divides, usually, into two or more branches, which ramify through the inner layers of the retina.

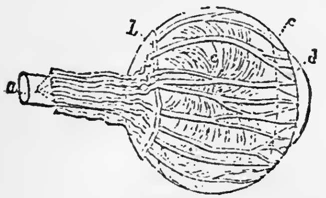


FIG. 4.

The *nerves of the eye* in addition to the optic, are the third, fourth, ophthalmic division of the fifth, and the sixth. The third is a motor nerve and supplies the superior, inferior and internal recti, inferior oblique, the levator palpebræ and ciliary muscles, together with the sphincter of the iris. It also sends a branch to the ciliary ganglion. The fourth nerve supplies the superior oblique, and the sixth the external rectus. The fifth sends sensory branches to the lids and conjunctiva, two to three long ciliary nerves to the eyeball,

and furnishes a sensory root to the ciliary ganglion. The *ciliary ganglion* is a minute flattened lenticular body which lies deep in the orbit between the optic nerve and external rectus muscle. It has motor, sensory, and sympathetic roots. From its anterior border several branches are given off which divide into fifteen or twenty, the short ciliary nerves, and these together with the long ciliary nerves from the third nerve, pass along the optic nerve sheath and pierce the sclera around the optic nerve entrance. The ciliary nerves (Fig. 4)

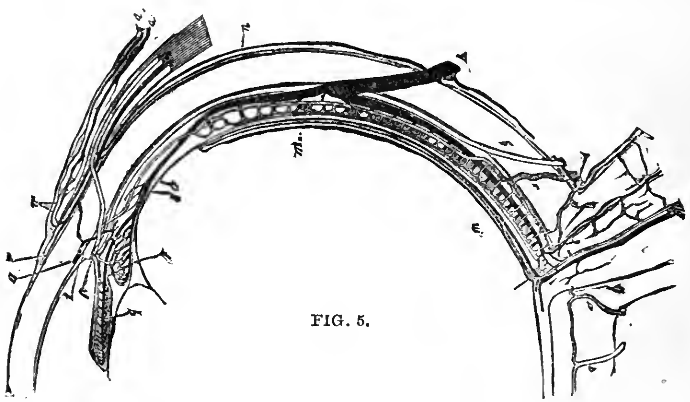


FIG. 5.

pass directly to the inner surface of the sclera and advance to the ciliary body where a plexus is formed which supplies the iris, ciliary muscle, choroid, cornea and blood-vessels.

The *blood supply* of the eyeball is divided into three systems: First, the short or posterior ciliary arteries (*aa* Fig. 5), which are derived from the ophthalmic, and consist of some twenty branches which pass through the sclerotic around the optic nerve entrance and supply the choroid together with the long ciliary arteries (*b* Fig. 5), two in number, having the same origin as the others, which perforate the sclera in front of the short, one on the nasal and the other on the temporal side, and then pass forward to form the complex vascular system of the anterior portion of the choroid, ciliary body and iris.

Second, the anterior ciliary arteries (*c* Fig. 5) which,

arising from the muscular branches, pass through the tendons of the recti muscles, pierce the sclera at four to six mm. from the cornea, and passing forward form the arterial loops in the margin of the cornea (*v*), and supply the ciliary body (*r*), the iris (*q*) and anterior parts of the sclera (*n*). They become visible to the naked eye only in inflammation of these parts.

Third, the central artery of the retina (*e* Fig. 5, Fig. 6), which enters the optic nerve about 15 to 20 mm. behind the eyeball, and passing to its centre emerges upon the optic papilla and there divides into two branches, one above and one below. These again dividing and arching out, supply the inner layers of the retina, leaving the portion occupied by the macula lutea comparatively free. (See Fig. 6). The veins of the cornea, iris and ciliary body follow closely the arrangement of the arteries, but in the choroid after numerous ramifications and anastomoses they unite into large whorls, the venæ vorticosæ (*v* Fig. 7 and *1* Fig. 8), which are four to six in number and have large trunks which pass out through the sclera near the equator, and carry off the major portion of the blood from the uveal tract. There are no veins corresponding to the long ciliary arteries. The venous blood from the eye is emptied through the superior and inferior ophthalmic vein into the cavernous sinus.

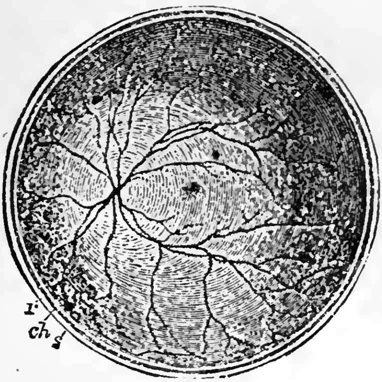


FIG. 6.

The *lymphatic system* of the eyeball is necessarily complex and extensive, from the fact that were blood-vessels used to carry the product they would interfere with distinct vision by lessening the transparency of the various tissues. Hence, the circulation of the nutrient fluid, in the form of colorless lymph, is carried on through these channels. Upon the interruption or rapidity of this flow depends the tension, or fluid pressure,

of the eyeball. The lymph formed in the different tissues of the eye, after having nourished the parts for which it is intended, passes out through three different channels, the canal of Schlemm, the spaces around the choroidal veins, and through the optic nerve. That formed in the anterior portion of the eyeball being principally derived from the iris and ciliary body; that secreted by the ciliary body, after supplying the vitreous and posterior layers of the lens, finds its way through minute openings in the zonule of Zinn. (*ZZ* Fig. 1) into the posterior chamber, where it is increased by that

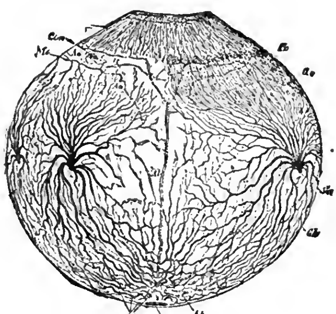


FIG. 7.

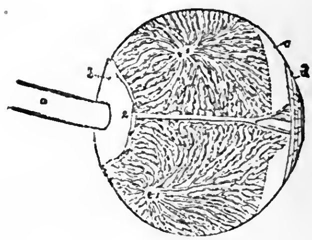


FIG. 8.

coming from the iris and thence passes into the anterior chamber between the iris and lens; the iris in its normal condition being so applied to the lens as to prevent any reflux into the posterior chamber, it mingles with the secretion from the anterior surface of the iris and, in part, from the membrane of Descemet and cornea. This commingled fluid finds an exit through the meshes of the ligamentum pectinatum at the angle of the iris into the canal of Schlemm (*Sc* Fig. 1), where it meets the lymph which has been used in nourishing the cornea, and passes out into the anterior ciliary veins. (c' Fig. 5). There is an unexplained resistance upon the part of the lymphatics which retards the flow sufficiently to preserve a proper tension of the fluid in the anterior chamber. The lymph formed in the choroid and sclera passes into the space between these membranes (*Pch* Fig. 3) which exists in the loose trabecular tissue formed by the supra-choroidea and

lamina fusca, which connect the two tunics, and which presents lamellæ covered by endothelial cells; around the trunks of the venæ vorticosæ (*h* Fig. 5) as they pass out through the sclera at the equator lymph sheaths have been described which communicate with Tenon's space, the lymph space between the outer surface of the sclera and inner surface of the capsule of Tenon, which extends along the optic nerve and thus gives exit to the lymph from the choroid and sclera to the arachnoidal cavity of the brain, through the canalus opticus. The third mode of exit, that for the lymph from the retina and inner portions of the optic nerve, is by canals around the blood-vessels, particularly the capillaries and veins passing out through the lamina cribrosa.

The lymph space of the optic nerve will be considered in the chapter devoted to the discussion of its anatomy and diseases.

PHYSIOLOGY OF THE EYE.

Rays of light falling upon the retina cause what is termed a sensation of light, but to obtain distinct vision of any object an image of that object must be formed on the retina. These rays of light impinging upon the retina, give rise to sensory impressions through some excitation of the nerve terminations in the retina. This excitation is accomplished by the mechanical irritation due to the vibrations of the luminous rays, to changes in the electric currents of the nerves, to chemical decomposition of certain matters in the retina, and to changes in the temperature due to the rays. These sensory impulses transmitted along the optic nerve through certain portions of the brain, and possibly modified in their passage, affect our consciousness and become sensations.

Luminous rays of light, passing through a bi-convex lens, which is a lens with two convex surfaces, are brought together at a point on the opposite side of the lens. These rays if they proceed from a luminous object, as a candle, diverge, and, falling upon the bi-convex lens, are again converged by it and

brought to a focus at a point behind it; if, now, a screen is placed at this point, an inverted image of the candle will be formed upon it. The eye may be considered as equal to a biconvex lens of $\frac{7}{8}$ of an inch or 22.65 mm. focal length by which inverted images as in Fig. 9 are formed upon the retina as a screen. Impressions made on the perceptive elements, cause local changes, the effect of which, when transmitted to the brain, is projected outwards in an inverted direction to the object, thus making us conscious of the existence of the form and position of objects, although in reality we only see the inverted images of them. Again, the fact that we see the image in its proper position, instead of inverted, is explained on the hypothesis that each cone conveys its own portion of the retinal image to the brain. For the formation of an image upon the retina, a dioptric apparatus is provided. This consists of a series of curved refracting surfaces and media, which are sufficient to bring rays of light to a focus upon the retina, and thus produce a well-defined image. These refractive media being transparent the rays of light enter the outer surface of the cornea, pass through the cornea, the aqueous, the lens and the vitreous. The cornea, aqueous and vitreous have the same refractive power or index, and the lens, although not possessing the same refractive power throughout, yet, owing to the difference in the density of its central and outer layers, may be considered as having a refractive power equal to the mean of the sum of its refractive parts. Thus, for the purpose of demonstration, the natural eye, instead of presenting these several refractive surfaces and media, is reduced to a "diagrammatic eye" in which the refracting surfaces are reduced to three, viz.: (1) The anterior surface of the cornea. (2) The anterior surface of the lens, separating the aqueous from the lens. (3) The posterior surface of the lens, separating the lens from the vitreous. The media are similarly reduced to

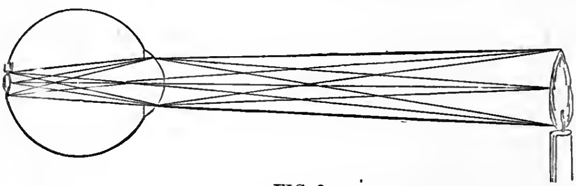


FIG. 9.

two: the mean index of the lens, and the aqueous or the vitreous. This diagrammatic eye becomes of great value in studying physiological optics where the calculations deduced represent those of the natural eye with sufficient accuracy for practical purposes. The calculated position of the *principal posterior focus*, that is, the point at which all rays falling upon the cornea parallel to the optic axis are brought to a focus, is in the diagrammatic eye 14.647 mm. behind the posterior surface of the lens, or 22.647 mm., about 23. mm., behind the anterior surface of the cornea. The fovea centralis, the point of most acute vision of the retina, must occupy this position in order that a distinct image of a distant object may be formed upon it. The values given in these calculations, however, refer to the eye when in a condition of rest and not in any effort of accommodation.

ACCOMMODATION.

Parallel rays of light entering the normal eye when it is in a state of rest, are brought to a focus upon the retina; light-rays coming from an object over twenty feet distant being sufficiently parallel for all practical purposes. If, now, these rays are rendered divergent, or the object is brought nearer to the eye, the rays no longer form an image upon the retina, but at some distance behind it, as the focal power of the eye, in this condition, is not enough to bend the rays of light sufficiently to bring them to a point upon the retina; hence, for the purpose of producing a well-defined image upon the retina, when an object is within an infinite distance, the eye possesses the power to adjust itself for

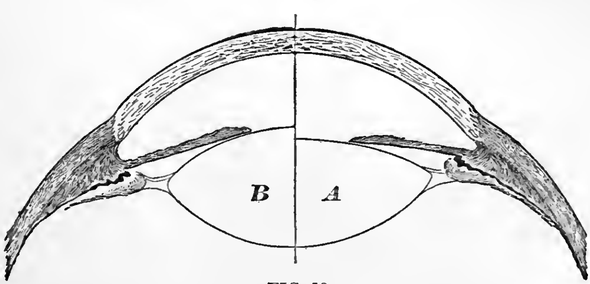


FIG. 10.

this distance. This power is termed the function of accommodation and enables the eye to focus near objects distinctly. This is accomplished by an increase in the convexity of the crystalline lens (*A* Fig. 10), chiefly on its anterior surface, whereby it becomes a lens of shorter focus (*B* Fig. 10). The lens is elastic and by reason of a peculiar arrangement of its fibres constantly tends to assume a more convex shape. The degree of convexity is controlled by the tension of its suspensory ligament, the zonule of Zinn, acting upon its capsule. In the act of looking at a near object the ciliary muscle contracts and bringing the ciliary processes closer together the zonule is relaxed, and the lens becomes at once more convex from its own elasticity. This elasticity diminishes from infancy with a corresponding diminution in the power of accommodation, until at forty years of age it becomes difficult to focus for a near point for minute objects. During the act of accommodation, which is an involuntary one, certain other changes in the eye take place, and the whole act may be summed up as follows: the pupil contracts, cutting off the more diverging rays, the front of the lens becomes more convex, and, advancing somewhat, carries the iris forward with it; the posterior surface of the lens changes slightly, its edges becoming rounded; the ciliary body increases in size and projects somewhat nearer to the centre of the eye. The main factor in the production of this adjustment of the eye is the ciliary muscle, the ring muscle of the ciliary body, which on contracting becomes thicker, causing a swelling of the ciliary body, and a movement of this process inward, thus relaxing the suspensory ligament.

The eye is by no means a perfect optical apparatus, but presents many defects owing to the curves of its surface not being perfectly spherical, thus producing a diffusion of the image from spherical aberration, or there may be a want of symmetry in the curves, as in astigatism. The media also are not perfectly transparent, and shadows of these imperfections are thrown upon the retina, presenting what is termed entoptic phenomena.

The region of most distinct vision is the macula lutea, and it is at this point that the images are focused upon the retina. Although all other portions of the retina are sensitive to light impressions, the images diminish in distinctness as they are removed from the yellow spot. The images of surrounding objects which are visible when the eye is fixed in any direction constitute the *field of vision.* The region of distinct vision is limited, however, to the macula lutea where only cones are present as terminal elements of the nerve structure of the retina. The optic nerve entrance, being entirely destitute of the rods or cones, presents a blind spot, or scotoma, in the field of vision, thus proving that the optic nerve fibres themselves are insensible to light. The size of this blind spot depends upon the distance of the field of vision from the eye. At eighteen inches, it amounts to the area of a circle of one inch in diamter. At the distance of the moon, this scotoma covers a field equal to thirteen diameters of the moon. To demonstrate this loss in the field of vision the experiment of Mariotte is employed. A cross is made on a sheet of paper, and $2\frac{3}{4}$ in. to the right, is drawn a black disc $\frac{3}{4}$ in. in diameter. Closing the left eye, the right is directed at the cross held about one foot away. On moving the paper to and from the eye, the disc will, at a certain distance, become invisible.

VISUAL PURPLE.

The discovery by Boll, sustained by the later investigations of Kuhne, that the rods of the retina were surrounded by a secretion from the hexagonal pigment cells of the retina, of a purple or rose color, which is formed in darkness and decomposed in sunlight, was supposed to determine the photochemical theory of light perception that the images of objects were impressed upon the retina by the decomposition of this coloring matter, and the fact that these images could be so fixed upon the retina as to be copied after death, seemed to add weight to this theory of the origin of visual impulses. The discovery, however, that the rods were the active agents

in the secretion of this matter, and its total absence from the central part of distinct vision, the macula lutea, where only cones are present, shows that further investigation will be required to determine its true function.

BINOCULAR VISION.

Though we have two eyes, the fact that we have binocular vision, or single sight, is due to the reception of the image upon symmetrical portions of the two retinas, which contain cones, the centers of which are probably centrally associated in the brain. To effect binocular vision, both eyes converge equally upon the object, and images are formed upon identical portions of the retina. These images blended in the brain give us, not only size and direction, but also relief, or the idea of solidity, of the object. With monocular, or vision with a single eye, we get only an idea of the size and direction, but not of the solidity of the object. If the images do not fall upon identical or corresponding portions of the retina, as the fovea, then two objects are seen, and double vision, or diplopia, results.

CHAPTER II.

METHODS OF EXAMINATION.

GENERAL EXAMINATION.

With a systematic mode of examination of eye patients, the surgeon quickly acquires the habit of rapidly diagnosing some eye affections from external appearances, thus rendering the result of complete inquiry into the full condition less liable to error. The history and symptoms of disease or injury of the eye are often necessary in the formation of a diagnosis, and should be supplemented by a personal and careful inspection of the eye and its appendages, before formulating an opinion or proceeding to treatment. A glance at the appearance and bearing of the patient may enable us, in some cases, to decide upon the part affected, and confirm the diagnosis by further examination. A person having lost vision from some retinal or optic nerve affection carries his head well up and eyes open; the cataract patient shades the eyes with the hand and advances more timidly. The astigmatic patient carries the head to one side, or with the lids half closed, as in myopia, or with the head bent forward and the eyes directed upwards towards the eyebrows, as in paralysis of the superior oblique muscle, where vertigo follows the attempt to look downwards. The half-closed eyes of one suffering from ptosis, or the trachomatous patient with his heavy lids, or again the patient suffering from some corneal or conjunctival affection where intense photo-

phobia requires covering the eyes to exclude all light, indicate the part affected and the probable diseased condition.

DETAILED EXAMINATION.

For the purposes of examination, the patient should be seated before a window which admits a clear, but not too bright light; the surgeon stands at the side, or if necessary to confine the head of the patient, a towel having been thrown over it, it is supported against the chest of the surgeon, who stands behind. In young children or infants, the body and limbs of the child should be held in the lap of an attendant while the head rests between the knees of the surgeon. If the eyes are sensitive to light and painful, or the patient so nervous as to interfere with a proper examination, it is necessary to administer an anæsthetic, as a complete inspection must be obtained.

In a *general survey*, we are obliged to determine by comparison of the two eyes whether one or both are affected; the presence or absence of squint, or loss of mobility of the eyes from paralysis of the muscles or the pressure of tumors from behind.

The condition of the lids as to wounds, scars, loss of motion as in ptosis, or loss of power to close them as in facial paralysis, inversion or eversion of their margins, the condition of the cilia, their irregularity, distribution or loss should be observed. The margins, whether normal in color and thickness, or red, ulcerated and thickened; and the presence or absence of tumors, swellings, or styes.

The *prominence of the eyeball* with loss of motion in any direction from orbital tumors, Basedow's disease, etc. The mobility of the eye being decided by having it follow a pencil held in front of the patient and moved in various directions.

The next thing to be done is *to open the eyelids* to gain a view of the front of the eyeball. This is done by placing the thumb upon the skin, above or below the eye, and by

gentle traction separating the lids. This must be carefully done so as not to give pain, or by making too much pressure upon the eyeball cause its rupture, as might easily happen in cases where the cornea is diseased. It will become necessary in some cases to use metallic retractors which are provided for the purpose. Upon opening the eyes the appearance of the cornea is shown, whether normally transparent or exhibiting the presence of foreign bodies, maculæ, or partial or complete clouding, as in pannus, pustular ulcerations and keratitis.

If the eyes are inflamed, determine what tissue is affected. If it is the *conjunctiva*, notice the color, amount and nature of the discharge, whether it be stringy, muco-purulent, or purulent. If only one eye is affected, or if no discharge is present, evert the eyelid and examine for some foreign body which may have lodged in the palpebral folds. The lower portion of the conjunctiva is easily brought into view by pulling the lower lid down. An examination of the upper portion requires the *eversion of the upper lid*, which is readily accomplished, after a little practice, by seizing the eyelid between the finger and thumb, and drawing it away from the globe, at the same time directing the patient to look downwards, while the third finger or a small probe-like object catches the upper border of the tarsus and pressing it down the lid is everted, and its conjunctival surface and the upper cul-de-sac brought into view. At a glance we take in the appearance of the lower portion of the conjunctiva, noticing whether it present the normal salmon tint and is smooth, or injected, thickened or granulated. If the source of irritation is not thus revealed, we may find it in the closure or eversion of the *lachrymal puncta*, which, instead of being directed towards and touching the conjunctiva of the ball, are turned upward or outward.

The eye may present a suffused appearance, or the tear fluid passes over the lid to the cheek, when pressure upon the sac-like swelling on the side of the nose near the inner angle of the eye will cause a flow of pus through the canaliculi into the eye, thus indicating an inflammation and stricture of the lachrymal sac.

The transparency of the *cornea*, the presence or absence of inflammatory or cicatricial spots, and irregularities of surface must be determined before making an examination of the deeper portions, or the appearances due to the shadows from irregularities or spots upon the surface may cause confusion when projected upon the lens or retina. Touching the cornea with a bit of paper will reveal at once, whether it possesses a proper degree of sensibility.

The color, mobility and shape of the *iris* are then to be noticed. If in a comparison of the color of the two irides we find that one differs in color from the other and the eye is inflamed, iritis should be suspected. In a healthy condition there is frequently a difference in the color of the two eyes, as one may be gray and the other blue; or one brown and the other yellowish brown; but if one is blue and the other greenish, we should look for inflammation, either present or past, of its structure. To determine whether the pupil dilates or contracts freely under the stimulus of light, the patient is placed before a moderately strong light. Covering the eye not under examination with one hand, the other is passed back and forth slightly in front of the eye to be tested, while at the same time the action of the pupil is noted from the side. If the iris is in a normal condition, it will dilate as the hand shades the cornea and contract the moment the light is allowed to strike the eye. Any loss of this power of action on the part of the iris is indicative either of mechanical obstruction, as when united to the lens capsule by present or former inflammations, or of retinal, optic nerve, spinal, or cerebral diseases. The pupils may present an enlarged and inactive condition, as in some cases of loss of vision in glaucoma and paralysis of the third nerve.

The character of the *pain* described by the patient will assist more frequently in deciding our prescription than in diagnosing the disease. In affections of the conjunctiva the sensation is usually described as smarting, burning, sandy, or as if the eye was full of sticks, etc., and indicates usually some superficial affection, which may, however be

a reflex one. Inflammation of the cornea, and particularly of the iris, presents severe pains, and an aching which is only rarely assigned to the eyeball, more frequently affecting the distribution of the fifth nerve about the eye. Pain deep in the eye, or behind the orbit is often an accompaniment of asthenopic troubles; while aching over the eye in the forehead and eyebrow, often extending back into the head, is an indication of fatigue of the accommodation, or some error of refraction, as astigmatism.

From the *vascularity* of the eyes, valuable information may be derived from a close inspection of the distribution of blood-vessels upon the surface of the eyeball. The vessels of the conjunctiva, which are invisible in health, present a bright red injection which extends up to the cornea, and is found to move with the conjunctiva as it is moved over the globe under the pressure of the finger upon the edge of the eyelid, indicating the presence of conjunctivitis. A second system of blood-vessels which become apparent in diseased conditions is that of the anterior ciliary arterial branches, consisting of small, straight, parallel vessels radiating from the cornea, which are not affected by any motion of the conjunctiva. This injection constitutes a pinkish ciliary zone which indicates some irritation, as a foreign body upon the cornea, or ulceration or inflammation of both the cornea and iris.

It becomes necessary to ascertain the *tension of the eyeball* in cases where the cornea, iris, ciliary body, or choroid are inflamed, or after injuries. Eyeball tension is readily obtained by directing the patient to gently close the eyelids and turn the eyes down, when the tip of the index finger of each hand is placed upon the eyeball over the closed lids and as far back on the sclera as possible; light alternate pressure is then made by the tips of the fingers, when the eyeball in its normal condition is felt to dimple under one finger, while at the same time a direct impulse from the fluids of the eye is given to the other finger. The normal tension of the eyeball, which is indicated by the symbol Tn., differs in different individuals, and at different times in the same individual. The tension

may be increased or lessened according to the amount of secretion which is retained in it. The degrees of tension are given as T, T+1, T+2, T+3; indicating first, normal tension, second, slight increase; third, decided increase; fourth, stony hardness. The eye at times shows a decreased tension as in eyeball atrophy and detachment of the retina. Here the various degrees of lessened tension will be indicated by the prefix of – before the degree of T; as T–1, T–2, T–3. In cases of doubt the interrogation point is used, as T+?, T–?.

TEST FOR COLOR.

It becomes necessary in our diagnoses to test the color perception, which is readily accomplished after the method of Holmgren, known as the confusion test. This consists of matching small bundles of colored worsteds of red, orange, yellow, green, yellow-green, blue, blue-green, violet, purple, pink, brown and gray. The patient is given a sample of the worsted and directed to select from the balance other bundles of the same shade as the given sample, which he does very readily if not color-blind. If, however, he is given a green sample and selects red or gray tints and places them with the other, the color perception for green is absent. If given a scarlet skein and he takes brown or dark gray, or dark-green shades, he is color-blind for red. These are the two most common forms of color-blindness. Where these tests are made for the examination of railroad and steamboat employes, instead of green or scarlet skeins, those of light purple or rose color should be used, as these colors are composed of red and blue. The red-blind will select blue shades to match with them, because he perceives only the blue in the purple, while if he is green-blind, he brings only the green sample to match the purple.

FIELD OF VISION.

To assist in diagnosing certain eye affections, such as glaucoma, hemiopia, and atrophy of the optic nerve, it becomes

necessary to examine the power of the eccentric portions of the retina to perceive objects. In the normal eye when the gaze is fixed upon an object, the eye being at rest, not only this object but many others lying within a circle extending some distance about it, are more or less distinctly seen. A distinct sharp image of the object looked at is formed upon the macula lutea, and is termed central or direct vision. The images of surrounding objects, which are perceived at the same time, are focused upon the portions of the retina beyond the macula lutea. The greater the distance from this point to the place where they are focused, the less distinct they become. This is termed peripheral or eccentric vision. The extent of this circle is termed the visual field, and it is frequently important to determine whether the normal limits are retained. The shape of this space is oval rather than circular, with the small end upwards, and the fixation point lies nearer to the nasal side, as the bridge of the nose interferes with the extent of vision in that direction, as does also the overhanging eyebrow in the upward direction. Various means have been devised for measuring the extent of the visual field. Ingenious instruments called perimeters have been invented for the purpose, but in ordinary practice, a blackboard two or three feet square having a white dot in the center will be sufficient. For testing the visual field, the patient should be seated before the blackboard so that the eye to be tested is about twelve inches from the surface of the board and in a line with the centre, then, having closed or covered the other eye, the eye to be examined is directed upon a cross-mark in the centre of the board. Then the surgeon slowly projects a piece of white chalk from the temporal side of the patient until he perceives it, when a mark is made upon the board at that point. In this way the chalk is carried in a circle around the centre of fixation, marking the most extreme points which the patient is able to see, while his vision is concentrated upon the dot. Lines connecting the various points thus made upon the blackboard form the boundary which encloses the field of vision. It may be roughly taken by having the patient close one eye and with the other look at a button upon the coat of

the surgeon, who stands in front of him; the fingers or an object held in them, then describes the circle, which is mentally registered by the examiner as forming the limits of the field of vision of the patient.

The *field of vision for colors* differs somewhat from that for objects, and diminishes in size for the various fundamental

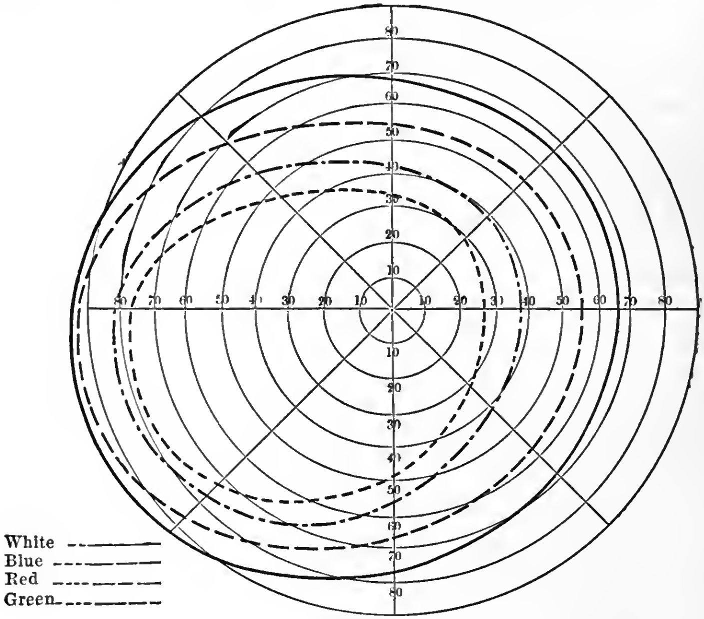


FIG 11.

colors, as in the chart Fig. 11, from blue which presents the largest field, through yellow, orange and red to green, which has the smallest visual field. The color field may be mapped in the same manner as above, colored chalks being used instead of the white.

TESTING THE ACUTENESS OF VISION.

To determine and record the condition of the vision, which may be impaired from a variety of causes, it was necessary that some standard of comparison should be agreed upon. For this purpose test types have been prepared by Snellen upon a definite scale, and the standard thus taken is the power

of the normal eye to distinguish the form of letters which in length are equal to the measure of an angle of five minutes, and the limbs of the letters are one-fifth the height of the letter in thickness, thus subtending an angle of one minute at a distance corresponding to the number of the letter. These types are arranged so that each size is numbered according to the distance in feet, or metres, at which it subtends an angle of five minutes. Thus, No. 1 is seen at one foot; No. XX at twenty feet. The acuteness of vision, denoted by the letter V, is expressed by a fraction of which the denominator is the number of the type and the numerator the number of feet at which it is seen. For example, the one more frequently used is No. XX of Snellen, which should be seen, in a well lighted room, at twenty feet. If these letters are read at that distance, then the *sharpness or acuteness of vision* is expressed as $V=\frac{20}{20}$. If, however, those which should be read at fifty feet, are alone seen, then $V=\frac{20}{50}$. The acuteness of vision thus measured is not always accurate, as many persons have the power to distinguish letters, say of No. XX, at still greater distances, but this test is sufficiently approximate for all practical purposes.

If the vision is so defective that the larger letters can no longer be distinguished at any distance, then the fingers should be held between the patient and the light, and the distance at which he is able to count them, noted. If the visual acuteness is still lower than this, he may yet be able to determine the kind and color of reflected light, and is then said to have only *qualitative perception* of light. If, however, he is only able to distinguish light from darkness, or notice the difference between light and shadow, as in cutting off the rays from a window or gas jet by passing the hand before the eyes, he retains only *quantitative perception* of light, and the vision only falls short of absolute blindness.

RANGE OF ACCOMMODATION.

The examination of the range of accommodation consists in measuring the distance between the nearest and farthest points

at which test types are seen, which should be read at one foot. Thus No. $1\frac{1}{2}$ of Snellen may be read up to within five inches of the eye, and also at a distance of eighteen inches. The difference between five inches and eighteen inches gives the range of accommodation. *Relative accommodation* is the term applied to the involuntary association of the accommodation with the convergence of the optic axis. In converging the eyes upon an object at a foot distant, we can accommodate for that distance or lessen or increase the accommodation without the exertion of the internal recti muscles, or without changing their position; the part which can be increased under these circumstances is termed the *positive accommodation*, and that which can be lessened without changing the convergence of the eyes, is termed the *negative accommodation*.

FOCAL ILLUMINATION.

For a clinical examination of affections of the anterior parts of the eye, as opacity of the cornea, changes in the iris, deposits on the lens in the pupil, cataract, pus or tumors which have extended forward into the vitreous, the *oblique* or *focal illumination* is applicable. This consists in converging the rays of light from a lamp or gas jet, in a partially darkened room, by means of a convex lens of two or two and a half inches focus. The lens, held between the thumb and finger, is used as a burning glass and brought close to the eye, so that the focused rays are brought to bear upon the part to be examined in an oblique direction. Thus the cornea, iris, lens and anterior portion of the vitreous may be successively examined by varying the position of the patient's eye, so that the focus of the rays will fall upon the part to be inspected. If desired, the pupil may be dilated with atropine to give a more extended view. The presence of minute foreign bodies projecting from the cornea, opacities in its substance and their depth, hemorrhage, pus or tumors immediately behind the lens, may thus be determined. A second lens may be held in

front of the eye thus examined, which will give a magnified image of the part under inspection.

EXAMINATION WITH THE OPHTHALMOSCOPE.

For an examination of the deeper parts of the eye, as the choroid, retina and optic nerve, the ophthalmoscope must be used. This instrument, which was invented by Helmholtz in 1851 and since improved by Coccius, Reute, Liebreich, Rekoss, Knapp, Loring and others, has revolutionized the science of ophthalmology and made it exact. Owing to the depth of the various tissues in the eye and the smallness of the pupil through which they are observed, it is impossible in their normal condition to examine them with the unaided eye. A tumor within the eye sometimes pushes forward the parts from the bottom, the pupil no longer appears black, and certain portions of the interior are thus made visible. The black appearance of the pupil, which was once supposed to be due to the complete absorption of the light rays by the dark pigment of the interior of the eye, is now known to depend upon the optical law of conjugate foci. The rays of light entering the eye pass through the cornea, aqueous, lens and vitreous, which together, in their refraction of light, may be considered as a single lens. When the eye looks at a gas jet placed at a short distance away, the rays, projecting into the interior, will form upon the retina an image of the jet. These rays are, however, reflected back from the retina, and in their passage are refracted by the eye until they meet again at the gas jet, where they form an image in the flame. These rays of light being limited by the size of the pupil, it is impossible for the

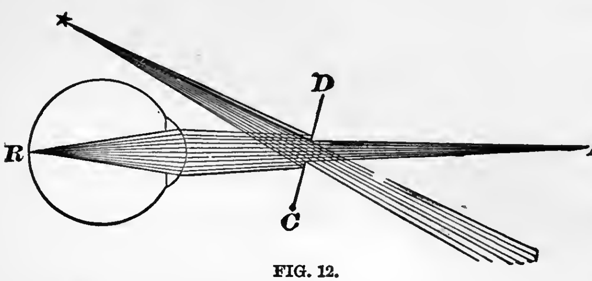


FIG. 12.

eye of the observer to catch a sufficient number of them to enable him to see the interior of the eye, and if his eye is placed in a direct line with the light coming from the eye under examination, the head of the observer at once cuts off the rays from the source of illumination. If, now, a piece of plain glass, or a small mirror be interposed between the observer's eye and the eye to be inspected, as shown in Fig. 12, and the light reflected into the eye by the glass or mirror, the interior of the fundus becomes at once illuminated and visible. Rays of light passing through the pupil and refractive media are, in the normal eye, brought to a focus upon the

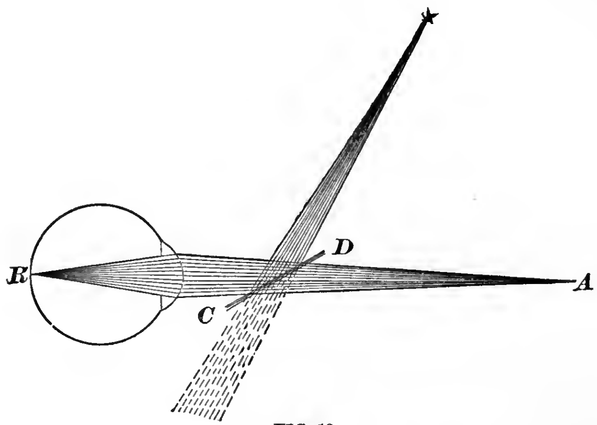


FIG. 13.

retina. A part of these rays are absorbed by the pigment of the retina, while the major portion follow the same course which they took in entering, hence the pupil appears black, because none of these light rays reach the eye of the observer. If, however, the examiner places before his eye a piece of glass, or thin plates of glass (*CD*) as in Helmholtz's ophthalmoscope (Fig. 13), at such an angle that the light coming from a luminous body is reflected into the eye under examination, the light rays in their return reach the glass reflector, and a portion of them pass through to enter the eye of the surgeon at *A*, and the pupil no longer appears black, but brilliantly red; this

is the essential principle upon which the ophthalmoscope depends.

KINDS OF OPHTHALMOSCOPE.

The ophthalmoscope consists essentially of a mirror set in a handle, a convex object lens, and a small ocular lens held in a groove behind the mirror, as in Liebreich's (Fig. 14), or contained in disks as devised by Rekoss which rotate upon each other to furnish a large number of lenses of different degree, as in those of Loring and Knapp, for the measurement of errors of refraction. The ordinary requirements of the ophthalmoscope, largeness of the field of view with good illumination, are well met in the small ophthalmoscope of Liebreich (Fig. 14), which consists of a concave mirror of about seven inches focal length with a central opening, attached to a short handle. The back of the mirror is provided with a clip for holding the necessary correcting lenses. Unfortunately they are usually so poorly made as to be almost useless. To keep pace with the advancement of ophthalmic science, more compendious instruments called Refraction Ophthalmoscopes have been devised by Wecker, Loring, Knapp and many others; the principle modifications consist in the substitution of detachable or revolving disks containing numerous correcting glasses, for the former clip, and changes in the size and shape of the mirror and its perforation. In the Loring instrument (Fig. 15) the mirror is concave and made very thin, with a focal length of seven inches and a central perforation 6 mm. in diameter. The handle is made long so that in holding it the observer's hand does not come in contact with the patient's face in the direct examination. The correcting glasses are held in disks which fit in a cell at the back of the instrument and are retained by means of springs, so that they may be

FIG. 14.

rotated in such a manner that the center of the glass comes opposite the center of the hole in the mirror. Less elaborate and equally good instruments have been devised by Loring for ordinary ophthalmoscopic work. These consist of a single revolving disk with perforations for twelve or sixteen convex and concave lenses, one space being left open to use when no correcting glass is necessary, and furnish a very satisfactory instrument for students and general practitioners. Loring has added many other modifications to his instruments, as in covering the disks, and the substitution of a tilting mirror of a parallelogram shape instead of circular. Knapp's double disk ophthalmoscope consists of the ordinary concave reflecting mirror as in Liebreich's, Loring's and others, but with a perforation 3.75 mm. in diameter. This is screwed on a thin plate of metal. On the other side of this metal plate are two disks, of which the upper contains the convex lenses and the lower a similar series of concave lenses. Each disk rotates on a central pivot and presses upon a delicate spring with a point-like elevation at the end, which fits into corresponding depressions in the disk, which arrest the disk when the lens which we want is opposite the centre of the aperture of the mirror. The two disks are covered by a metal cover which prevents the soiling of the lenses. The disks overlap at their margins in such a way that each convex glass can be covered by a concave glass. Thus combinations are formed and an extensive series of lenses obtained. The disks are rotated in position by the finger tip applied to the top and side of the instrument. Apertures in the back enable us to read the

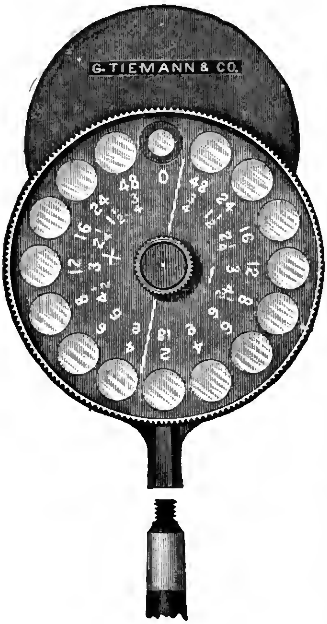


FIG. 15.

numbers of the lenses which are behind the opening in the mirror. A short ivory handle screws into a socket in the mirror plate.

The single disk instrument of Knapp (Fig. 16) is very similar to Loring's smaller instrument. The disk contains an

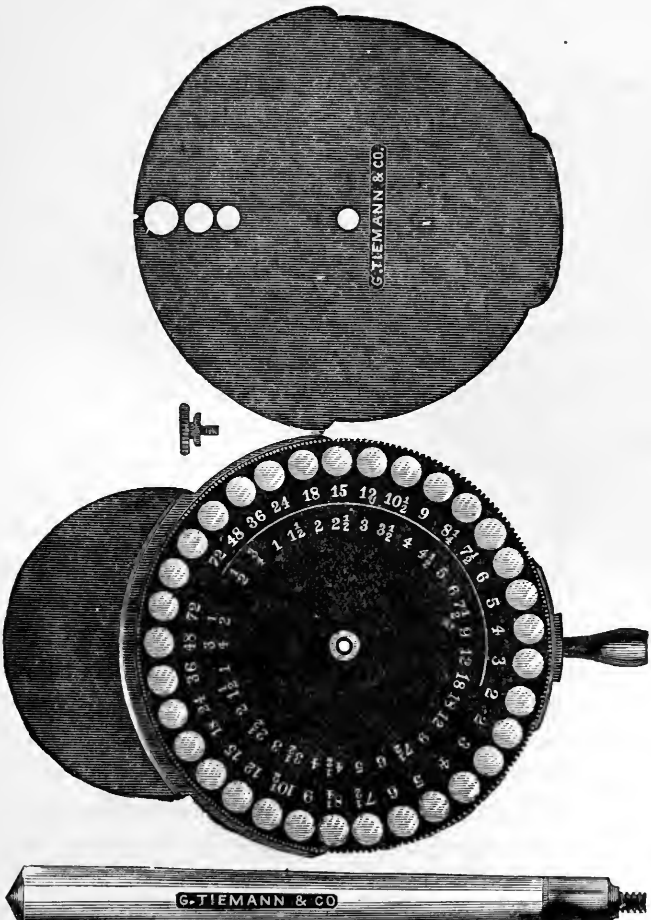


FIG. 16.

empty hole and twenty-three or more lenses which are covered by metal, and is easily rotated by the finger without losing the ophthalmoscopic image for the time.

THE USE OF THE OPHTHALMOSCOPE.

Direct Method.—A well-darkened room should be provided, with a good light from an argand lamp, or gas jet, which should be above or at one side and a little behind the patient, so that his face is in the shadow. The light should not be too intense, as the strong reflection causes too great contraction of the pupil and fatigues the patient. To acquire the skill necessary to see with the ophthalmoscope, frequent examinations should be made upon healthy eyes, as the instrument can only be used with satisfaction after much practice. The patient should be seated in front or to the side of the surgeon, the light being to one side of the patient and on a level with his eye, so that the eyes of both are on the same plane. If the left eye is under observation, the surgeon holds between thumb and fingers the handle of the ophthalmoscope, with the mirror in front of his left eye, and resting the upper edge upon the under side of the eyebrow. The light is reflected by the mirror into the eye. Now if the eye of the patient and also the eye of the observer are possessed of normal refraction and the accommodation relaxes, the pupil appears illuminated at once, and the red reflection from the fundus is obtained. The condition of the lens and transparency of the vitreous are now examined. The beginner may be satisfied if this much is obtained during the first attempts with the use of the instrument. If, now, the patient's eye is directed upwards slightly, the color of the reflection is changed to yellow by the light falling upon the optic disc, which is much lighter in color than the other portions of the fundus. Having now approached still closer to the eye until the faces almost touch, the arteries and veins upon the disc become plain and the details of the fundus are carefully studied out. The image thus seen in the direct method, is not a real image, but a *virtual erect image* which appears as if situated some distance behind the patient's retina. If, at any time during the examination, the observer exerts his accommodation, or places a glass behind the mirror the image

disappears. The direct image on the retina is seen by this method only when the eye of the patient and that of the observer are of normal refraction, when the eye of the patient is hypermetropic and the observer's myopic to the same degree, or when the patient has a myopia which is counterbalanced by a similar degree of hypermetropia in the surgeon.

The use of convex glasses behind the mirror produces an artificial myopia in the eye of the observer, while concave lenses similarly applied produce artificial hypermetropia. The use of the ophthalmoscope in determining the degree of the errors of refraction will be discussed in the chapter devoted to the errors of refraction.

With the direct method the beginner may have much difficulty in relaxing his accommodation, owing to the close proximity of the eyes. This may be overcome by the use of a convex glass behind the mirror until he has acquired the knack of relaxing his accommodation. With the examination by this method a larger image is obtained than with the other and the exact position of the lesions of the fundus is more accurately determined. The extent of surface of the fundus seen at any one time is less than with the indirect method and depends upon the distance between the two eyes. At 15 mm. it equals the size of the pupil. The nearer the eyes approach the larger the field; the farther removed, the smaller the field. If the eye examined is not normal but hypermetropic, then a convex glass equal to the degree of hyperopia must be used behind the mirror before the fundus becomes distinct. If a normal eye examines a myopic eye, then a concave lens of the degree of nearsightedness must be used. In each of these cases the image is less magnified than in the normal eye, but is larger in the myopic than in the hypermetropic eye.

Indirect Method.—The position of the patient and surgeon are the same as in the foregoing method, but their heads are separated to a distance of eighteen to twenty-four inches. The ophthalmoscope, with a convex lens of sixteen or twenty-four inches focus in position behind the hole in the mirror, is slightly turned toward the light so that the reflection is

thrown into the eye, and the red reflexion of the pupil made apparent. With the left hand, a convex lens (*L* Fig. 17) of two and a half or three inches focus is held between the thumb and fore-finger parallel to the front of the eye, the third finger resting upon the median line of the forehead of the patient and giving support to the hand, while the little finger can be employed to raise the lid if necessary. The lens is thus held about two inches in front of the eye, so that the rays of light reflected on the mirror of the ophthalmoscope are focused by the convex lens in the pupil.

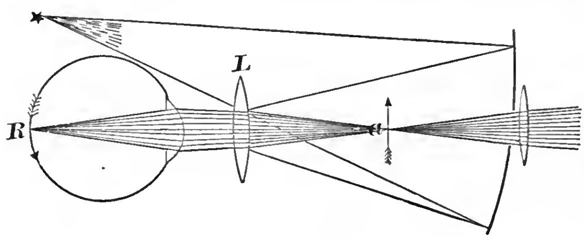


FIG. 17.

The patient is now directed to look in a direction past the surgeon's ear, which brings the optic disc in a line with the pupil, and on moving the head nearer or removing it farther from the eye under examination, a whitish object appears in the illuminated pupil. Slight variations in the position of the head, mirror or lens, which must be acquired by practice, enable the surgeon to obtain a clear and well defined image of the entrance of the optic nerve into the eye, and, following the course of the arteries and veins in their ramification through the fundus from this point, the whole of the interior can be studied by having the patient move the eye in various directions. The image now seen is a magnified *real* and *inverted image* (*a* Fig. 17), which is really formed in the air between the ophthalmoscope and the lens held before the eye of the patient. The size of the image depends upon the object glass used, and upon the refraction of the eye. If a three-inch lens is used and the eye normal the increase is five and a half diameters. If the eye is hyperopic, it will be larger, if myopic, smaller than with the normal eye. The image thus seen can be further enlarged by using a weaker convex object glass, say

a four-inch, which must be held farther from the eye of the patient, and also still further increased by having a stronger convex lens behind the mirror, say one-eighth.

OPHTHALMOSCOPIC APPEARANCE OF THE NORMAL FUNDUS.

The cornea, aqueous, lens and vitreous in the healthy eye, being perfectly transparent, are invisible and present no reflex under examination with the ophthalmoscope. The *fundus* of the healthy eye when brought into view through

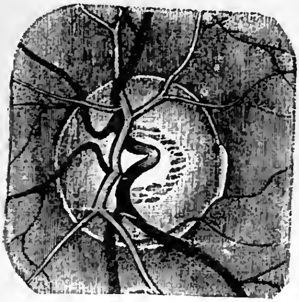


FIG. 18.

the pupil, presents a reddish-orange reflection in blonde people where the retinal pigment is not sufficiently deep to prevent the reflection of the light from the choroidal vessels. In brunettes, the pigment being darker, these vessels are obscured, and the light reflected from the pigment through the retina gives it a grayish color. The fundus of the eye, when viewed by the ophthalmoscope, presents for examination, first, the *optic disc* (Fig. 18), or entrance of the optic nerve. This, when the patient is looking in the proper direction, changes the red reflection of the interior to a whitish hue which fills the pupil and presents a well-defined outline. This light color is due to the absence of the choroid and retina at this point. Around this disc is a still whiter collar, due to the scleral fibres surrounding the entrance of the optic nerve, and termed the *scleral ring*. In other cases this circle presents a dark or black appearance due to the retinal pigment, and is termed the *choroidal ring*. At times, this pigment forms only a segment or crescent. These pigmentary deviations are not to be mistaken for pathological changes. The surface of the disc frequently presents a more or less opaque white portion, which is due to a depression of the central portion of the nerve, and is termed the *physiolog-*

ical excavation. It varies in size, but rarely occupies the whole extent of the disc, and should not be confounded with the cupping which occurs from pressure, as in glaucoma. Upon the disc, vessels are seen emerging at or near its centre. These are the central artery and vein of the retina. The *artery*, which is smaller and of a light red color, and presents a double contour or light streak along the centre, usually divides into two branches, one running upward, while the other takes a downward course, again dividing and ramifying through the retina. The *veins*, which are larger and of a darker color and more tortuous, are usually three in number: two coming from below and one from above, and uniting in the centre to form the central vein.

Further inspection of the disc shows smaller vessels upon its outer portions. These are nutrient capillaries, and give to it the reddish appearance. The *retina* being perfectly transparent, nothing is seen except the ramifications of the arteries and veins which sweep off from the optic disc. Possibly, slight, fine lines near the disc and along the main branches of the vessels may be apparent and are due to slight opacities in the *optic nerve fibres.* In brunettes or negroes the retina presents a bluish film which is more apparent near the optic nerve, where the retina is thicker. If the retina appears hazy, the difficulty may be due to want of transparency in the cornea, lens or vitreous. This, of course, should be determined before further examination of the retina. The *choroid*, from its large vascular supply, gives to the fundus its red tint, but nothing is seen of it with the ophthalmoscope, except that where the retinal pigment is abnormal, the outlines of the venæ vorticosæ and of the choroidal vessels become apparent. If the pigment layer is thin, as in blondes, or absent, as in Albinos, then the choroidal vessels become visible and present a striking picture. These vessels are easily distinguishable from those of the retina, as they present a lighter appearance, are much larger, not traceable to the optic disc, and present no light streak. The *macula lutea* and the *fovea centralis*, its minute

depression, are examined with difficulty unless the iris and the accommodation are paralyzed by atropine, as it lies in the direct line when the patient looks at the hole in the mirror, and the exercise of the accommodation and the consequent contraction of the pupil and the puzzling reflections, prevent its being observed in more than one-third of the cases examined. It appears as a minute red spot, sometimes surrounded by a yellowish or whitish ring; the latter is more frequently observed in dark-complexioned children. The absence of any change in the retina more frequently determines its normal condition than the appearance of the part itself. The *sclera* is not seen in an examination of the fundus, unless the choroid has been destroyed or atrophied, when it appears of a glistening white at the point of lesion.

KERATOSCOPY.

Keratoscopy is an additional method of examination which has been recently introduced for determining the refraction of the eye, and requires for its application a concave ophthalmoscopic mirror. The patient may be seated about forty inches distant, with the light to one side, so that it falls upon the mirror and is reflected into the pupil of the eye to be examined in a very oblique direction. Looking through the perforation of the mirror a red reflection is obtained, and approaching or removing farther, a clearly defined image is formed; this image is surrounded by a dark shadow and moves with any rotation of the mirror. The observer's eye must be normal, or corrected by a suitable glass behind the mirror, and then upon rotation of the mirror the image and shadow will be found to move in the opposite direction if the eye be hypermetropic, emmetropic or slightly myopic. If the eye is more myopic the image and shadow move in the same direction as the rotation of the mirror. To determine the amount of the error, lenses are rotated behind the mirror, until, in the case of hyperopia, the image moves

with the rotation of the mirror. The glasses prescribed by this method are always stronger than the practical glass, and it is not likely to supersede the more exact method of Ophthalmoscopy.

CHAPTER III.

GENERAL CONSIDERATIONS OF TREATMENT.

USE OF ANÆSTHETICS.

In regard to the use of anæsthetics, it may be said that while many operations upon the eye are excessively painful, there are also many which are not so, but seem very alarming to the patient, and the nervous anxiety accompanying the announcement that an operation of any kind is necessary is sufficient to deprive them of self-control. Even if an immediate consent is obtained, the patient is oftentimes unable to withstand even a very minor operation upon the eyeball, as the motor muscles are but slightly under control of the will under these circumstances, and unless the utmost care and patience are exercised by the surgeon, the agitation of both the eye and the patient are apt to so interfere with the operation as to render his skill less likely to achieve a favorable result. For the many delicate operations upon the eye it is much better to render it perfectly passive by the use of anæsthetics and thus prevent any spasmodic movement of the eye, or sudden compression of the ball by the sudden closure of the lids, during or at the close of the operation. In regard to the choice of anæsthetics the author believes that ether, while consuming more time in its administration, is otherwise as suitable for all operations upon the eye as chloroform and presents much less risk.

BANDAGING.

In diseases or injuries of the eye absolute rest of the part may be necessary for the purposes of healing, for the friction of the lids as they move over the cornea or conjunctiva may become not only painful but injurious. For the purpose of preventing the movements of the eye and thus securing perfect rest during the process of repair a bandage is used. This may be of two kinds, *compress* or pressure and *retaining* bandage. A *compress* bandage is applied after first covering the eyelids with a small square of thin linen or muslin, and picked lint (charpie), absorbent, or borated cotton, placed bit by bit upon this in such a manner as to fill up all the irregularities of the surface to a level with the brow, the lighter portion of the packing coming upon the lids over the most prominent portion of the eyeball. The bandage is made of a strip of soft flannel or merino $1\frac{1}{2}$ inches wide and $1\frac{3}{4}$ yards long and rolled. When both eyes are to be bandaged the length must be increased to $3\frac{1}{2}$ yards. In its application the free end of the roller is applied to the temple on the side of the affected eye, and the roller is then carried around the head to the starting point. It is now carried down obliquely across the occiput and under the ear and then brought up over the covered eye with slight tension of the edge of the roller nearest the nose, pinned to the layer on the forehead, reversed and carried above the ear, thence down across the occiput and up over the eye as before, tension being made this time upon the outer edge of the bandage and pinned as before, the roller turned and the end secured by pinning above the ear. If desired, a third layer may be applied to the eye. When both eyes are to be covered the double pressure bandage is applied in the same way except that the bandage is laid flatter and after the first layer has been brought to the median line of the forehead the pin is put in horizontally, the roller reversed and carried down over the second eye so that the inner layer of the bandage of the first eye becomes the outer layer of the second, and is passed down under the ear

and below the occiput and brought up under the ear and over the first eye, reversed to cover the second eye and the end secured as before. After removal of the eyeball or the contents of the orbit, the packing should be more solid and the bandage applied with greater pressure. A figure eight bandage may be used for the same purpose; the end of the roller is applied at the median line of the nape of the neck and passed forward over the face on either side as desired, and along the line of the nose and across the root of the nose to the other side, thence over the occipital prominence, then around and over the second eye, down the face to the back of the neck opposite the beginning. Continue in this way until two lines of bandage are laid on each eye and then the balance carried across the head and pinned. Difficulty is experienced in keeping any form of the bandage in position for any length of time, and extra pinning or stitching together will be necessary. The wearing of a light knit night-cap over the bandage will often serve an excellent purpose in retaining it in proper position.

As the condition of the eye improves, or when it is necessary to make frequent applications to it a *retaining* bandage is substituted for the pressure bandage. A convenient form is made of one or two thicknesses of muslin $2\frac{3}{4}$ inches wide by 7 inches long, either square or tapering at the ends to which tapes are attached. Two tapes are fastened at one end and one at the other. The bandage is to be applied diagonally across the eye which has been covered with a bit of soft linen, upon which is placed a small mass of absorbent cotton; one tape from each end is carried to the back of the head, crossed, brought forward and tied in front, while the remaining tape is carried below the ear on the side of the well eye, around to the back, thence over the top of the head, and pinned where it crosses the others.

For *retaining wet dressings* on the eye a muslin bandage $1\frac{3}{4}$ inches wide and 1 yard long is required. It is used in the following manner: Begin at the top of the ear and pass up a little in front of the vertex and then around the head

below the occiput, and with the finger beneath the bandage above the ear, draw firmly and pin; the loose end of the bandage is then carried over the compress and pinned to the head band. For both eyes a right-angled head bandage is used.

EYE SHADES.

For simple protection of the eyes from direct light, colored protective glasses made of plain tinted glass, preferably the smoke-tint, may be used, the tint to be determined by the nature of the case. For more full protection eye shades made of card-board and covered with black silk are very comforting to the patient in many cases and allow of his taking the exercise which may be needful in hastening recovery.

COLD AND HOT APPLICATIONS.

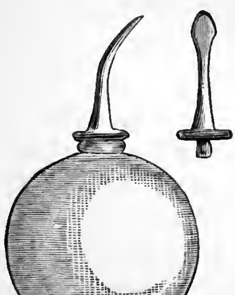
There are many conditions of the eye where the application of cold or heat alleviates pain, retards reaction or promotes resolution. These may be wet or dry according to the necessities of the case. The temperature of the applications may usually be left to the choice of the patient. The time of the application is to be regulated by its effect and the severity of the inflammatory process. As a rule it is better to apply them only for a few minutes, or half an hour, rarely an hour, and then after an interval of half an hour, an hour, or longer re-apply them. During the interval the eye is to be cleansed and a bandage applied if necessary.

For *cold applications* wet compresses can be used, formed of several thicknesses of old linen soaked in cold water, or laid upon a large piece of ice in a basin near the bedside, and changed as often as required. If dry cold is to be used, a small rubber ice-bag filled with chopped ice, and placed within the folds of a clean towel so that at least one thickness of the towel comes between the ice-bag and the eye, is laid upon the eye and retained in position by pinning the ends of the towel behind the head, or to the pillow. This form of

cold application can be used in cases of conjunctival inflammation for several hours at a time with benefit and comfort.

Hot applications may be used dry, by means of hot flannels, bags of hot bran or hot salt, as in the ciliary neuralgia of iritis, or flannels wrung out of hot water, compresses wet in a warm decoction of chamomile flowers, calendula, or hops, and poultices of pulverized slippery-elm bark, or flaxseed, as in suppurative cases of the lids, orbit, or cornea. Moist heat must not be applied continuously for any length of time as œdema and relaxation of the tissues result, and ulceration or slow recovery follows. Eye douches are used in some chronic cases, a stream of water being directed against the closed eyelid from a fountain syringe, the temperature of the water being that which is most grateful to the eye.

CLEANSING THE EYE.



G. TIEMANN & CO

FIG. 19.

For removing discharges from the eye small bits of old muslin, linen, camel's-hair brushes or absorbent cotton or the sub-palpebral syringe of Dr. Liebold (Fig. 19) may be used. With whatever method employed, the end is better attained by the use of some disinfectant lotion. Chlorine water, which may be diluted one-half or one-third, or used in full strength, as the irritation after its use is very slight, forms one of the best disinfecting lotions. Boracic acid, grs. viii ad f℥i, is more frequently at hand and gives good satisfaction.

MYDRIATICS AND MYOTICS.

Certain substances which possess the power of dilating or contracting the pupil when applied directly to the eye have received the name of mydriatics and myotics. Among the mydriatics are sulphate of atropia, hydrobromate of homatro-

pine, belladonna, hyoscyamine, daturine, gelsemium, and the sulphate of duboisia. Until a recent period atropia sulphate has been considered the most useful and important of the mydriatics, but homatropine and duboisia are now filling needed places in the armamentarium of the oculist. They are all poisonous and exert their toxic effects on passing through the tear passages to the throat and there becoming absorbed. For general purposes where the dilation of the pupil is desired, the *solution of sulphate of atropia*, grs. iv. ad f℥i of water, will furnish the best mydriatic. In its application a drop is to be placed in the lower conjunctival fold with a medicine-dropper (Fig. 20), and in ordinary cases after twenty minutes or half an hour the pupil will be found to be fully dilated. The paralysis of the ciliary muscle follows in from one and a half to two hours, lasts a day, but does not entirely disappear for one or two weeks. It also acts as an anodyne in relieving the reflex irritation from the nerves of sensation of the cornea and iris. Where care is not used in its frequent application, the symptoms of *atropine poisoning* may occur. These are usually, first dryness of the throat, then flushing of the face, headache, palpitation of the heart, acute mania, delirium, retention of urine, urging to urinate, nausea and prostration. On the occasion of any of these symptoms the use of the atropine should be stopped and draughts of black coffee administered until vomiting takes place, or morphia or brandy may be given if the prostration is great. If the atropine is dropped into the eye near the outer canthus and the head held to that side for a few moments or pressure made over the lachrymal sac the poisonous effects are not likely to prove troublesome. In young children a solution of $\frac{1}{8}$ gr. to the f℥ should be used. In rare cases atropine produces irritation or inflammation of the conjunctiva. In these cases *sulphate of duboisia*, grs. iv ad f℥i, will prove useful. It has the same effect upon the eye as the atropine, the full effect being obtained in an hour, but

FIG. 20.

lasts only about six hours and its influence disappears in about seven days. Its toxic effects appear more rapidly and are more alarming, and are usually vertigo, unconsciousness, or extreme prostration. *Homatropine hydrobromate*, grs. xvi ad f℥i, one to three drops, in the eye dilates the pupil and paralyzes accommodation in an hour, but the effect passes off in 24 or 36 hours. The other mydriatics mentioned above are rarely if ever used in ophthalmic practice now.

Of the myotics we have the *hydrobromate of pilocarpine* and the sulphate of eserine. The former is mild in its action and has been recommended as a local tonic for the ciliary muscle. In a solution of gr. iv ad f℥i, it produces contraction of the pupils and spasm of the ciliary muscle, the effect passing off in 36 to 48 hours. The *sulphate of eserine* is a more powerful myotic, a solution of grs. iv ad f℥i causing the utmost contraction of the pupil, and spasm of the accommodation with pain, in half an hour to an hour; its effects are transient and disappear in a few hours. It is used to draw the iris away from a peripheral ulceration or wound of the cornea, to counteract the paralysis of the iris or ciliary muscle and in some cases of glaucoma to draw the periphery of the iris away from the angle of the iris, thus lessening the pressure upon the canal of Schlemm.

INSTRUMENTS.

In all operative procedures upon the eyeball, the lids must be held apart by the fingers of a competent assistant, or Desmarres's

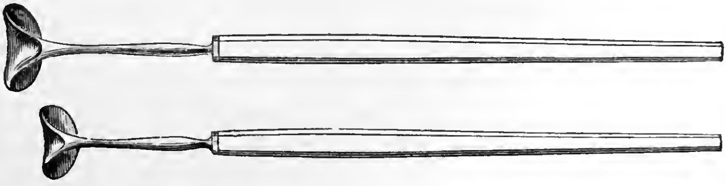


FIG. 21.

lid elevators (Fig. 21) employed, or a *speculum*, designed for the purpose, used. A variety of the latter instruments have

been devised and are in use by different operators. The requisites of a proper speculum are that the lids should be as widely separated by it as the palpebral fissure will allow, it should not cause any pressure upon the eyeball, and should not project from the lids or temple so as to interfere with the manipulations of the surgeon. There is no single speculum which is well suited for all purposes. An ordinary wire speculum will answer for many cases. That of Noyes (Fig. 22) is as well adapted as any form of spring speculum for common use, but is often impracticable when the eyes are deep set. That of Liebold (Fig. 23) possesses admirable features, as when properly made the body rests on the temple and conforms itself to the action of the face. It is out of the way of the operator. There is no spring action, the limbs being governed by a slide to which a small thumb-screw is affixed. With the

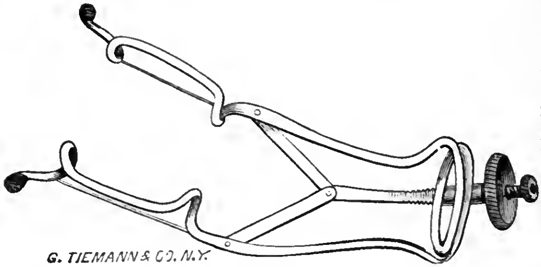


FIG. 22.

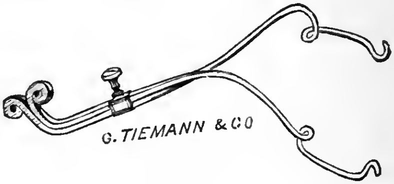


FIG. 23.

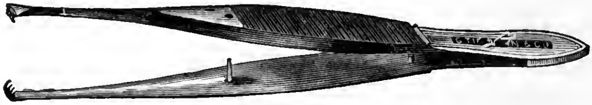


FIG. 24.

spring speculums it has happened to all operators, during the removal of the speculum after an operation, that on turning the instrument slightly it has slipped from the fingers and perhaps struck the eyeball. This accident might prove serious after an operation for cataract, iridectomy, etc., and is avoided by the use of Liebold's speculum. The speculum is readily introduced by slightly lifting the upper lid and inserting the

upper limb of the speculum and then the lower lid is retracted sufficiently to allow the lower portion of the instrument to rest in the lower conjunctival sac.

For steadying the eyeball a *fixation forceps* (Fig. 24) is used, and this may be made with or without a spring catch. It should be handled so as to simply turn the eye by slight pushing and not drag it. The application of the forceps becomes painful and if not carefully manipulated it will tear the con-

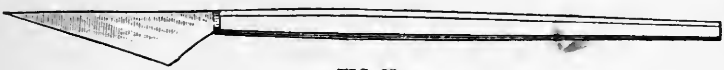


FIG. 25.

junctiva. The *Beers knife* (Fig. 25) will be found a very useful form of scalpel for operations about the eye, the blade being very thin, well pointed, and yet sufficiently firm for all purposes. The great variety of other instruments are specially designed for particular purposes and will be considered under the descriptions of the different operations.

CHAPTER IV.

WOUNDS AND INJURIES OF THE EYE.

The proper management of traumatic injuries of the eye is of the utmost importance, as the resulting condition of the eye depends very much upon the treatment to which it is subjected immediately after the injury. The full extent of the injury should be ascertained, and frequently it will be necessary to etherize the patient, particularly if a child, to gain a complete inspection of the eye. Where practicable, the vision should be tested and noted, as a direct examination of the eye frequently has a legal aspect as well as a surgical one. Having determined the parts injured and the extent of the lesion, and decided upon the treatment necessary, give the eye perfect rest and refrain from frequent examination, which may retard the process of repair.

INJURIES OF THE ORBIT.

The orbit is often the seat of punctured and gunshot wounds which may or may not directly implicate the eyeball. Blows directed upon the margin of the orbit may cause simply a congestion of the soft parts with ecchymosis of the lids, or produce a *fracture* of one of the orbital walls. The presence of effused blood beneath the conjunctiva of the bulb, within a few hours or just following the injury, is an indication of rupture of the blood-vessels of the orbit. A careful ophthalmoscopic examination should be made, as serious changes may result at the same time internally or behind the eye. Oftentimes a

fracture of the orbit is overlooked in other serious injuries of the head and is followed by loss of sight in one or both eyes without much change in the fundus. Rest, cold applications, and arnica locally and internally, are usually sufficient, the blood being absorbed in a few days. *Punctured* or *gunshot wounds* of the orbit demand a thorough search for foreign bodies by means of the little finger or probe and their immediate removal, when found. If the entrance wound is not sufficiently large to permit the removal of the imbedded object, it must be further enlarged. In cases where small shot, as bird shot, are projected into the tissues of the orbit, those near the surface should be removed, but deep incisions and probings in the structures of the orbit are not advisable, as these foreign bodies if left to themselves frequently become encysted, or come to the surface after a time. The direction of punctured and gunshot wounds, demands consideration and affects the prognosis of this class of injuries, for, if the roof is implicated, hemorrhage, inflammation and abscess of the brain may result. If the floor of the orbit has been fractured or punctured, blood from the nose is often symptomatic, and besides the opening of the antrum, injury to the infra-orbital nerve may result. In the treatment of these injuries of the orbit all foreign bodies, fragments of bone, etc., are to be removed, the parts thoroughly cleansed, and cold compresses applied, with rest and the maintainance of a free opening for discharges. If orbital cellulitis supervenes and abscess forms deep in the orbit, an incision to allow free discharge is imperative, and if cerebral complications ensue, it may be necessary to remove the eyeball.

INJURIES OF THE LIDS.

Wounds of the lids, however extensive, must be thoroughly cleansed with warm water, all portions of clothing, hair, dirt, etc., removed, the edges of the wound well brought together and united with as many fine sutures as may be necessary to insure a full adaptation of the lacerated tissues, when primary

union will almost always take place. Generally the application of dry dressings is all that is necessary. If, however, the wound becomes painful, cold compresses of calendula water and the use of Aconite, Arnica, or Calendula internally are indicated.

The *ecchymosis* of the lids or "black eye" from contusion requires the use of Arnica externally and Hamamelis internally. *Incised wounds* of the lids may cause ptosis from the division of the levator palpebræ, or if in the supra-orbital region, loss of sight as well. *Burns of the lids* may cause changes in the position by the resulting cicatrices and require the same treatment necessary for burns of the cuticle elsewhere. Superficial burns of the eyelids become more important than similar burns on other portions of the skin. If the lids are severely burned or scalded, lint soaked in a solution of lime water and linseed oil, or a thick paste of bicarbonate of soda should be applied to the parts. The latter I have found relieves pain more rapidly than any other dressing. Occasionally Cantharis will do good in lessening the tendency to suppuration which follows in these cases. Where cicatrices form, plastic skin operations will have to be considered later. Gunpowder grains imbedded in the tissue of the lid require the most painstaking effort at their thorough removal.

INJURIES OF THE LACHRYMAL APPARATUS.

Foreign bodies sometimes find their way into the lachrymal conduits, as lashes, hairs, bits of straw, etc., and should be looked for in the puncta when the irritaticn is not found elsewhere. Where these ducts have been divided by *wounds*, the repair cannot be expected to restore the integrity of the parts, and future operations may be necessary to open them.

INJURIES OF THE CONJUNCTIVA.

The injuries sustained by the conjunctiva are numerous, and in extent usually greater than those of the eyeball. They may consist of incised wounds, burns, or foreign bodies upon

or in its tissue. *Foreign bodies* impinging upon the surface of the conjunctiva are usually washed off by the profuse secretion of tears caused by the irritation, unless the efforts of the patient to remove them by rubbing, imbed them in the tissue. If a small fly, or other minute insect, or foreign body becomes lodged in the eye, it is usually found near the palpebral margin of the upper lid, each movement of the lid causing severe pain as the object scratches upon the cornea. Upon eversion of the upper lid it is removed without difficulty. If it remains for any length of time, or an eye-stone is inserted, conjunctivitis results, but rapidly subsides upon the removal of the foreign body or eye-stone. *Gunpowder grains* become imbedded in the conjunctiva from explosions, and necessitate the removal of all free grains, and the excision of minute portions of the conjunctiva together with those grains which become imbedded in its tissue. This may be done immediately after the injury has been received, or, if the reaction is too excessive from the injury to other parts, their removal may be left until some future time, when the eye has recovered from the immediate effects of the injury.

Incised wounds or *lacerations* of the conjunctiva require little, if any, treatment, beyond the use of cold compresses and enforced quiet of the eye by bandaging, as they heal very readily. *Burns* of the eye from lime, mortar, molten metals, ammonia, sulphuric and nitric acids, or other caustic substances are very common, affecting the conjunctiva, and requiring the installation of such oily substances as cream, vaseline, sweet oil, etc., which may be at hand. In the case of lime or mortar, all particles must be carefully picked from the conjunctival fold by forceps or a spud, and syringing may be necessary to remove more minute bits. Etherize the patient, if necessary to do it perfectly. After all have been removed, instil castor oil or vaseline between the lids and keep the eye at rest. Burns from melted metal are usually less deep than those of lime, as the metal solidifies rapidly and is more easily removed. Eschars are produced from acetic, sulphuric, or nitric acids, or concentrated lye; and after the parts have been well washed

with water the reaction must be waited for. The use of alkaline solutions in the case of acids, or acid solutions in the case of the introduction of alkalies into the eye is misleading, as the danger is usually done before the antidote in either case can be applied, and the superficial injuries sustained by their dilution in large quantities of water, are very slight. The danger in burns of the conjunctiva, from whatever cause, is from adhesion of the granulating surface after the eschar has been discharged, and this union of the conjunctiva of the lids and globe cannot be prevented any further than by the constant instillation of oil, and perhaps the frequent breaking up of the cicatricial bands by the probe. The adhesions which form from the contracting cicatrix requires future operation. If these burns have not involved the cornea, there is no necessary impairment of vision, unless the adhesions are sufficient to impede the motion of the eyeball so that its movement is not associated with its fellow.

INJURIES OF THE CORNEA.

Foreign bodies, particles of iron, cinders, seed husks, etc., become imbedded in the cornea, and may present only slight, if any, irritation for several days, after which time inflammation or pain occur. In the removal of these foreign bodies if

FIG. 26.

FIG. 27.

the eye cannot be controlled, an anæsthetic must be used, Under ordinary circumstances, the patient may be seated upon a chair of ordinary height before a good light with his head resting upon the chest of the surgeon, who stands behind. The operator fixes the eyeball with the thumb and fore-finger of the left hand, and making slight pressure upon the margin of the orbit, the eyeball is well controlled. In a majority of

cases, with a sharp gouge (Fig. 26) or spud (Fig. 27) in the other hand, the foreign body will be raised and removed without difficulty. If, however, the hand is not steady, the other portions of the cornea are touched and the pain will be severe. If a foreign body extends into the deeper layers of the cornea, or into the anterior chamber it will become necessary to enter a narrow cataract knife through the anterior chamber and by cutting outwards, remove it, or, using the knife tip for a rest, the foreign body may then be seized by a pair of forceps and withdrawn. The after-treatment of such cases is, as a rule, very simple. The instillation of a drop of atropine and the application of a bandage, even in those cases where the cornea has been incised are, oftentimes, all sufficient. In cases of foreign bodies simply impinging upon the cornea, the use of a lotion of aconite tincture and water relieves the pain from exposure of the nerve filaments in the cornea, and hastens repair. If suppuration has commenced about the point of entrance of the foreign body, atropine two or three times a day will generally relieve the pain, while the use of Aconite, Hepar sulphur, Silicia, or Mercury, as the case may indicate, will hasten the reparative process. Scars that may be left will injure vision according to their position and extent, by lessening the transparency of the cornea. *Abrasions* of the surface from the scratch of the finger-nail of a child or a twig, require usually only a bandage and rest for the eyes during forty-eight hours, until the epithelial layer has again been re-produced. If occurring in nursing women, or where there is a low condition of the system, suppuration of the cornea and destruction of vision may result. *Contusions* of the cornea from direct blows upon the eyeball are rare, but usually cause suppuration, keratitis, or abscess, and become one of the most dangerous affections of the eye. Such results follow more frequently in aged persons than in the young, and arise from small objects striking the cornea directly, and as all abscesses or suppurations of the cornea are followed by some opacity, the vision thereby becomes defective. In the treatment, cold applications, and Arnica are the first indica-

tions. If suppuration becomes established, the temperature of the applications must be changed, and thin compresses wet with a hot infusion of calendula flowers applied for half an hour at a time several times a day, and the administration of Hepar or Silicia may assist in improving the condition. The presence of pus in the anterior chamber may necessitate paracentesis to draw off the aqueous and thus lessen the tension.

The cornea is frequently the seat of *incised wounds* resulting from explosions, direct cuts or thrusts from various objects. If the wound is merely an incised one, it may be extensive without necessarily destroying the vision; however, if the wound is at all extensive there is loss of the aqueous humor, and frequently prolapse of the iris into the wound; where there is no hernia of the latter present, the eyelids should be closed, after the instillation of a drop of atropine, and a bandage applied, the patient being confined to the bed and every effort made to give the organ absolute rest, and thus facilitate the union which takes place in a few days. If there is *prolapse of the iris*, it is not advisable to attempt to return it to the anterior chamber by any manipulation, as the pressing of these delicate parts results in iritis and further complicates the case. The projecting portion of the iris may be cut off close to the cornea with a pair of curved iris scissors. If the iris is caught in the wound during the progress of healing and bulges by reason of pressure from the aqueous behind it, it should be punctured with a cataract knife until by gradual contraction it heals without projection; sometimes the iris tissue degenerates into a cystoid condition which will require opening with a cataract knife, and close dissection with fine scissors of the tissue down to the cornea, the application of a bandage, and maintainance of rest until the wound again heals. Small incised wounds of the cornea, if no other portions of the eye are injured, are almost harmless, as they heal very rapidly. Wounds of this portion of the eye are more frequently complicated by contusion, hemorrhage, prolapse of the iris, wounds of the lens or deeper structures, and hence become much more grave.

INJURIES OF THE SCLERA.

Wounds lying in the sclera are, as a rule, much more dangerous to the integrity of the eye than corresponding ones of the cornea. The unyielding nature of the fibrous tissue of the sclera and the prolapse of the vitreous prevent the edges of the wound from coming into close apposition, and hence it heals with difficulty. Fine sutures may be introduced and the wound brought together, with very excellent results in some cases. *Rupture* of the sclera may result from direct compression of the eyeball, as in a blow from a closed fist, blunt instrument or a fall. The seat of rupture is usually at the upper and inner portion near the junction of the cornea, or between the cornea and insertion of the recti muscles. If sufficient to occasion a rupture of the sclera it will cause severe injuries to the other structures of the eyeball, the lens frequently being driven out through the opening, the vitreous may follow, and the eyeball collapse. Again, detachment of the choroid or retina may accompany the injury from rupture of the blood-vessels of the choroid. Wounds of the sclera become dangerous from the fact that the ciliary body, choroid and retina may prolapse in the wound during the process of healing and cause sufficient irritation to set up sympathetic irido-choroiditis in the other eye, and necessitate the removal of the injured eyeball. Hence the prognosis should be very guarded, as often in slight cases of detachment of the retina, degeneration of the vitreous and other more remote changes may result. In cases where the lens, choroid, or ciliary body are prolapsed in the wound and the eyeball collapsed it is better to remove the eyeball at once as it has already become sightless. In some cases of rupture of the sclera, the wound may lie towards the posterior portion and thus be hidden from inspection. The lessened tension, which is always present in ruptures of the sclera, will cause us to suspect it in this case.

INJURIES OF THE IRIS.

Wounds of the iris are usually accompanied by injuries to other structures. The prolapse in cases of wounds of the

cornea has already been considered. *Incised wounds* of the iris alone are extremely rare. When occurring they cause an effusion of blood into the anterior chamber, which obscures the iris. This blood is usually absorbed in thirty-six hours, when a cut will be found at the place of injury, as the wound does not unite, owing to the absence of inflammatory action in this case and the separation of the parts. Rest and quiet of the eye are necessary until the blood has been absorbed, when the extent of the injury can be ascertained and the prognosis made accordingly. *Detachment of the iris* from the ciliary body, in whole or in part, may occur from injuries affecting only the iris or also involving the cornea. Blows received upon the eye may cause a separation of the iris from a portion of the ciliary body; after the effused blood has been absorbed, a second pupil, as in Fig. 28, will be observed, but that portion of the pupil will be irregular, and the iris, from laceration of its nerves and muscles, will not respond to the stimulus of light; the vision will be somewhat impaired by the increased amount of light which is thus admitted to the eye causing confusion of the retinal image. Re-attachment of the iris is not possible, but rest should be enjoined until the eye has recovered from the effects of the blow, or of deeper injuries, such as detachment of the retina, which may complicate the case. A complete detachment of the whole of the iris may occur, as it has in two cases which have come under my notice: the first, where the iris was injured by a thrust from a wad-remover, which caused a lacerated wound of the cornea and removed over two thirds of the iris, the remaining portion being prolapsed in the wound. In the second case the cornea was incised by a cut from a broken bottle, and the iris prolapsed, and was removed entire by the unskillful attempt to remove the prolapse. *Foreign bodies* which pass through the anterior chamber often lodge upon the iris, where they rarely become encysted, though I have seen one case in which

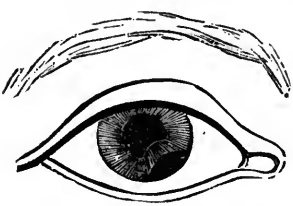


FIG. 28.

a bit of wood remained encysted in the iris for several years without causing trouble. Foreign bodies in this region are readily discovered by focal or oblique illumination. If a foreign body has lodged upon the iris, an opening in the cornea should be made with an iridectomy or cataract knife, the iris forceps introduced, and the portion of the iris containing the foreign body seized and brought out, the iris then excised, atropine solution introduced, and the eye bandaged. No delay in the removal of foreign bodies should occur here, and if the eye is already inflamed an operation is still more imperative. If the foreign body consists of iron or steel, an opening into the anterior chamber may be made, when the introduction of the point of a magnet into the wound may be sufficient to attract the particle, and upon withdrawal of the magnet the bit of iron or steel follows. All injuries of the iris, whether from incised wounds or foreign bodies, require the instillation of a solution of atropine, four grains to the ounce, to dilate the iris ad maximum and retain it there until all symptoms of inflammation have disappeared. The dilatation of the pupil will also enable us to form a prognosis, as a wound of the lens at a part covered by the iris in its undilated state may thereby be revealed, and thus affect our prognosis and cause a change in the line of treatment.

INJURIES OF THE LENS.

Ruptures of the sclera from blows may cause at the same moment loss of the lens from the eye, or if the conjunctiva remains intact, the lens becomes dislocated beneath it. The sac of conjunctiva thus formed may also contain blood, vitreous or prolapse of the iris. The tension of the eyeball is lessened and it feels soft under the pressure of the fingers. The lens usually gives shape to the sac and renders diagnosis more easy. If the anterior chamber is clear, the loss of support of the iris from the absence of the lens gives it a tremulous appearance, and if the iris is prolapsed distortion of the pupil follows. The anterior chamber, however, is

frequently filled with blood and obscures the condition of the interior. The prognosis is usually unfavorable; the lens may be removed by an incision from the conjunctival side, or allowed to become absorbed without removal, and if no more serious injury of the eyeball has been sustained, recovery may be good. The treatment consists in placing the patient in a recumbent position, and in preventing motion of the balls by a bandage, applying cold, and avoiding all muscular effort of the face as in chewing, coughing or straining at stool. If the lens is only partially in the wound and presses upon the iris, it should be removed; otherwise it is better to delay the removal of the lens until the scleral wound is healed. Suppurative inflammation of the globe may be the result of an injury of this kind and will require the treatment to be described further on. *Dislocation of the lens* may be partial or complete; if forward into the anterior chamber it should be removed promptly or increased tension follows, and the pressure upon the iris existing for any length of time causes inflammation of its structure which rapidly extends to the choroid. If the dislocation is backward into the vitreous, the lens may be allowed to remain undisturbed and may become encysted or absorbed. Punctured wounds of the lens, if of slight extent, may cause opacity of a small portion of it. If the capsule of the lens is lacerated to any extent from this cause *traumatic cataract* results. I have seen Cannabis indica and Conium clear this up, where medication followed immediately after the injury. The operation of discission will be demanded at some future time, or if the lens becomes much swollen, and extrudes from its capsule into the anterior chamber, from imbibition of the aqueous through its torn capsule, the pressure thus made upon the iris may endanger inflammation, and the removal of the whole lens in its capsule may be necessary to prevent the transmission of sympathetic trouble to the other eye.

Foreign bodies may lodge upon the capsule or enter the lens and thus produce an opacity of its structure, or blows received upon the eye may cause traumatic cataract by rupture of its

capsule at the periphery. Foreign bodies in the lens rapidly produce a cataractous condition and occasion inflammation which may extend to the iris and choroid, and thus cause sympathetic cyclitis of the other eye. In all cases of injury to the lens, the iris should be dilated and the eye kept at rest by a pad or bandage, and if inflammatory symptoms supervene, it will be necessary to etherize the patient and make an iridectomy and remove the lens, upon the occurrence of any marked increase in the tension. The changes in the transparency of the lens, in injury to the eyeball, may not follow for some days or weeks after the accident has occurred.

INJURIES OF THE VITREOUS.

Among the accidents occurring to the vitreous humor after concussion or punctured wounds beyond the lens, is *hemorrhage* from the ruptured blood-vessels of the choroid. The vision is quantitative, the patient being able to distinguish between light and darkness only. It is important to ascertain the extent of the field of vision, to enable us to determine whether there has been detachment of the retina or choroid. Owing to the impossibility of examination with the ophthalmoscope, we can only determine this by testing the patient in a dark room with a lamp or candle, which is held four or five feet from him, and the position of which is changed so as to define the field of vision, which, if found to be good, indicates no detachment of the retina. If the field is very dim above and clear below, partial detachment of the retina is diagnosed, or if the field is absent, total detachment may have occurred. Hemorrhage into the vitreous becomes absorbed very slowly, four to six weeks usually being required to clear up the blood, a floating scotoma resulting from the fibrin of the blood not infrequently remaining behind. Rest of the eye and a compress bandage are indicated, while the internal administration of Arnica, Hamamelis, and Crotalus will hasten absorption.

Foreign bodies, such as fragments of percussion caps, grains of shot, small metallic chips, glass or stone find, after passing

through the cornea or sclera, a resting place in the vitreous humor. These bodies, if very small, occasionally become encysted and the eye escapes immediate harm, but sooner or later the eye is lost, and there is only the question of immediate removal of the eye, or its removal at some future time when the condition demands it. If the foreign body is of large size, no time is to be lost in the enucleation of the eye, as the danger of sympathetic inflammation is very great. The position of bodies in the vitreous may be determined by the ophthalmoscope, if the media are clear and they lie not too far forward; usually, however, the passage of foreign bodies through the vitreous sets up an inflammation of this tissue and consequent opacity. Frequently they pass through the vitreous, and rebounding lodge upon or in the ciliary body where they rapidly excite destructive inflammation and require the early removal of the eyeball. Where particles of iron or steel enter the eyeball, they may be removed by the aid of Knapp's foreign-body hook (Fig. 29), or a magnet, the point

FIG. 29.

of which is inserted through the wound of the sclera, if present, or if the position of the chip can be determined by the ophthalmoscope an incision may be made through the sclera beneath the foreign body, the point of the magnet introduced and the foreign body be withdrawn with it. It usually happens that the particle is caught in the edges of the incision, whence it must be removed by a pair of fine forceps; in this way the eyeball may be retained, but the vision is almost always destroyed, either by the inflammatory process which follows, or from the effusion of fluid beneath the retina at the wound. If suppuration has begun about the foreign body the removal, while admissible, is generally impossible, and the eye must be enucleated.

The accompanying cut (Fig. 30) shows Dr. Gruning's magnet, which consists of several magnetized steel bars, fitted into

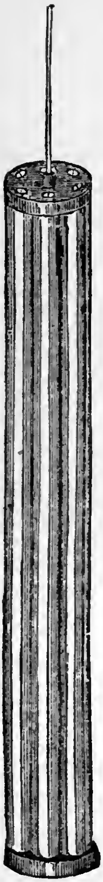


FIG. 30.

malleable iron caps, and provided with a projecting delicate point. It is capable of sustaining a weight of 15 grammes, or 225 grains, and will attract chips of iron weighing from 1 to 50 centigrammes at a distance of 1 to 5 mm. in the vitreous.

INJURIES OF THE CHOROID.

The choroid may be ruptured by the reception of blows upon the eyeball without external injury to the sclera or cornea. Such injuries are accompanied by hemorrhage into the interior of the eyeball, followed by sudden and complete loss of vision, or passing between the choroid and sclera the hemorrhage causes a detachment of the former, or, if occurring beneath the retina, lifts up that membrane, and, if excessive, finds its way into the vitreous. These hemorrhages are rapidly absorbed under the use of Arnica, Hamamelis, Lachesis and Crotalus and rest for the eye, and frequently leave no trace except a displacement of the pigment layer along the line of rupture, which usually shows itself about the posterior pole of the eye. Inflammatory changes in both retina and choroid may result.

INJURIES OF THE RETINA.

Injuries of the retina usually co-exist with those of the choroid and are mainly those of detachment from blows which cause effusion of serum or blood between the choroid and its tissue, and destroy sight in proportion to the amount of tissue separated. Its re-attachment after injury is rare; however, absolute rest in a recumbent position and bandaging, with the administration of Arnica and Gelsemium may accomplish much.

CHAPTER V.

ERRORS OF REFRACTION.

REFRACTION.

The refraction of the eye is the ability which its media possess, when the eye is in a state of rest, to bring parallel rays of light to a focus upon the retina without muscular effort. Rays of light coming from a luminous body diverge in all directions from it, but at a distance of eighteen or twenty feet they are practically parallel, hence all distances beyond this point are considered infinite, and those within twenty feet are called finite.

Parallel rays of light passing through a convex lens (*A* Fig. 31) in a direction parallel to its axis, are so converged that they are brought to a point behind the lens (*F*) at a distance equal to the focal power of the lens. This point is termed the principal focus of the lens. The focal power of the lens depends upon the curvatures of its surface and the index of the refraction of the material of which it is composed. Substances differ in their power of changing the direction of the rays of light, and the measure of this power is called the index of refraction. When divergent rays of light (*P* Fig. 32) fall upon a convex lens near its axis

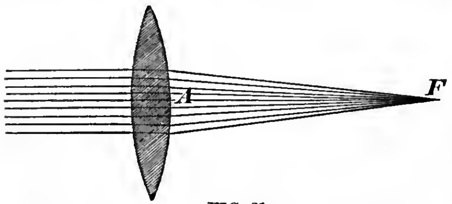


FIG. 31.

and come from beyond the distance of its principal focus (F) they converge to a point (P') beyond the focal distance of the lens. The point (P) from which the light diverges to fall upon the lens, and the point (P') at which the rays are again united, are termed conjugate foci.

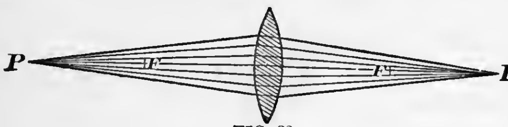


FIG. 32.

When parallel rays of light fall upon a concave lens in a direction parallel to its axis, they pass through and diverge from it as if they came from a point (F Fig. 33) on the inner side of the lens; this point (F) is the principal focal point of the lens and in concave lenses is a negative one.

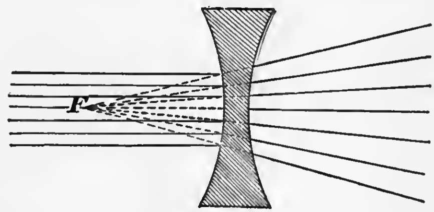


FIG. 33.

Where the length of the eye is normal, and the eye is in a state of rest, the layer of rods and cones in the retina forms the principal focus of the cornea and crystalline lens, which constitute the lens system of the eye and may be considered as a combined convex lens. The refractive power of the eye, then, is the ability which its media have of bringing parallel rays of light to a focus upon the percipient elements of the retina when the accommodation is relaxed. These rays of light, on being reflected from the retina, pass out from the eye in a parallel direction. The focal distance of the lens system of the eye is about $\frac{20}{25}$ inch or 20 mm. measuring from a point in the anterior chamber; the focal length of the cornea being 31 mm. and that of the lens 43 mm. The length of the optic axis, the line (FF' Fig. 34)

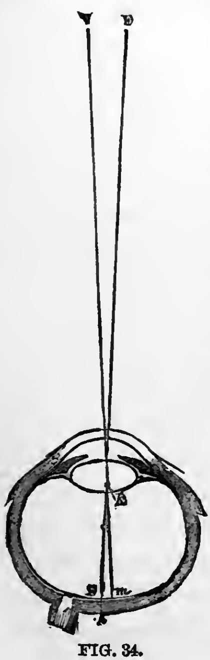


FIG. 34.

drawn through the center of the cornea to a point midway between the macula lutea (m) and the optic nerve entrance (o) is 24 mm., while the visual axis, the line (Vm) which joins the point of the object looked at with the macula lutea, measured from the cornea, is about 23 mm. These two lines cross at the nodal point (k) of the dioptric media of the eye and form an angle which is called the angle alpha (a) and measures about $5°$, decreasing when the eyeball is elongated as in myopia, and increasing when it is shortened as in hypermetropia; the angle being determined by the position of the yellow spot in reference to the axis of the cornea. The nodal point (k) is the optical centre of the eye and is situated near the posterior surface of the crystalline lens. The angle formed by the crossing of the visual rays at the optical centre determines the size of the image formed on the retina. The nodal point changes with the effort of accommodation. It may be advanced or caused to recede by placing a convex or concave lens in front of the eye, when the retinal image is also affected, being increased by the former and diminished by the latter.

EMMETROPIA AND AMETROPIA.

The eye is said to be emmetropic when its refractive power is such as to bring parallel rays of light to a focus upon the retina when the accommodation is in a state of full relaxation, and also when it possesses the faculty of increasing this refraction by the exercise of the accommodation to such a degree as to form well-defined images from divergent rays. The vision of such an eye is perfect for distance, and the use of even a weak concave or convex glass lessens the distinctness of the image. An eye to be *emmetropic*, or normal, must have an antero-posterior diameter of about twenty-three mm.; if the axis is longer or shorter than this the eye becomes *ametropic*, and parallel rays, with the accommodation at rest, are not brought to a focus upon the retina, but either in front or behind it. In practice we do not usually employ atropine or other

mydriatics to paralyze the accommodation in determining the refraction, hence we must make allowance for this. An eye which is emmetropic has the vision made worse by the use of a convex glass, and the vision is not further improved by the use of a concave glass. If a convex glass placed before the eye does not disturb the vision or actually improves it, then hypermetropia is present; if it is improved by a concave glass then myopia becomes apparent. In Fig. 35, which shows the relative length of the hypermetropic, emmetropic and myopic eye, the retina of the hypermetropic

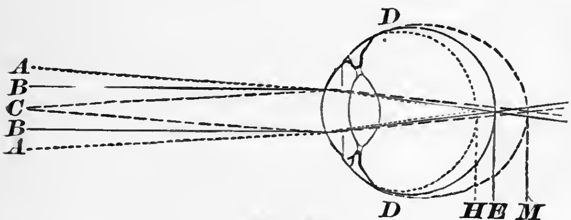


FIG. 35.

H is in advance of that of the emmetropic *E*, while that of the myopic eye *M* lies behind. Parallel rays from *B B* are brought to a focus in the hypermetropic eye at *E*, or behind its retina *H*, unless the accommodation is exercised, while in the normal eye the focus is at *E* and in the myopic eye at or near *E* in front of its retina *M*. Divergent rays of light from *C* are brought to a focus at *H* and *E* by the exercise of the necessary accommodation in the hyperopic and emmetropic eyes, and also at *M* in the myopic eye without the aid of the accommodation. Astigmatism, another form of ametropia, is only a combination in the same eye of different states of refraction, or of different degrees of the same form of ametropia. An emmetropic fundus in a direct examination with the ophthalmoscope gives a clear erect image at three or four inches from the eye.

SPECTACLES.

For the correction of the errors of refraction certain optical aids are used which are called spectacles. These consist of suitable lenses mounted in frames which hold them in proper

position before the eyes. The lenses are made ordinarily from a good quality of crown glass, or transparent quartz, the so-called pebble glass. The former is more frequently used as it presents the same density throughout and is better adapted for the purpose of refraction. The latter is harder and less likely to become scratched, but possesses no other qualities which would make it preferable to glass. The frames may be made of various metals or of rubber, shell, etc., which have their various advantages as regards weight, adornment, etc. The spectacle frames are better suited to their use as regards shape, as the lenses are held firmly in position before the eye by the nose-piece which rests upon the bridge of the nose, and the temple pieces which press the sides of the head, or hook behind the ears. Eye-glasses are more suitable for temporary use, and being attached to the clothing are always at hand, ready for use. The glass should be placed as close to the front of the eyes as possible and yet not have the cilia touch them. The centre of the lens should come directly over the centre of the pupil, unless it is desired in certain cases to get a prismatic effect also from the glass, which is done by decentreing the lenses or placing them more widely apart. Lenses are ground of various kinds, those most frequently used being bi-convex, plano-convex, bi-concave, plano-concave, convex or concave meniscus and cylindric.

Two systems of numeration for spectacle lenses are in vogue, the old or inch, and the metrical system. According to the old system a lens of one inch focus was taken as the unit and the glasses numbered accordingly; hence the focal length was expressed by using fractions; but as the inch is not a standard unit of measurement, differing in various countries, the metrical system has received much favor. In the latter system a lens of one metre, or 39.37 Eng. inches, focal length is taken as the unit; for convenience it is called a *dioptric* and, for brevity, the symbol D is used. As the glasses most used are of a greater refractive power than the unit, the majority are expressed by whole numbers. A lens of half a metre focus, would have twice the power of the unit,

and its measure would be two dioptrics or 2D; of one-fourth of a metre, four dioptrics or 4D; of twice the length of a metre, one-half a dioptric or expressed decimally .5D. The + sign before the number of dioptrics indicates a convex glass; — a concave lens, *s.* a spherical, and *cyl.* a cylindrical lens. The numeration of the old system can be approximately converted into the metrical system by multiplying the fractions of the old system by 40, which is nearly the length of a metre. For instance, a lens $\frac{1}{10} \times 40 = \frac{40}{10}$, or four dioptrics, 4D; $\frac{1}{20} \times 40 = 2$, or 2D. Conversely a lens of 4 dioptrics equals $\frac{4}{40} = \frac{1}{10}$ or a lens of 10 inches focus. The following table gives the relative values of each:

Focus in Inches.	*Number in Dioptrics.*	*Focus in Inches.*	*Number in Dioptrics.*
160	0.25	9	4.5
80	0.50	8	5.
60	0.67	7	5.5
50	0.75	6½	6.
40	1.00	6	6.5
36	1.11	5½	7.5
30	1.25	5	8.
24	1.5	4½	9.
22	1.75	4	10.
20	2.	3¾	10.5
18	2.25	3½	11.
16	2.5	3¼	12.
14	2.75	3	13.
13	3.	2¾	14.
12	3.25	2½	16.
11	3.5	2¼	18.
10	4.	2	20.

Spherical convex lenses are ground by the use of a concave tool which is a section of a sphere. Spherical concave require a convex tool for grinding, by which the concavity is ground into the glass. The common forms of lenses are as represented in Fig. 36, viz., the bi-convex *A*, the plano-convex *B*, the convex-meniscus or periscopic *C*, the plano-concave *E*, and bi-concave *D*, and the concave meniscus *F*. Cylindrical lenses are formed by grinding a curved surface into the glass with a

cylindrical tool, so that in the direction parallel to the axis of the cylinder there is no curve, but at right angles to the axis, a curve is formed which is equal in focal length to the curve of the cylindrical glass desired. Although simply refracting the light without formation of an image, they are numbered according to the laws governing spherical glasses; they may be plano-cylindric, bi-cylindric, or, when combined with spherical glasses, sphero-cylindric. Care is necessary in setting cylindrical lenses in spectacle frames, as the slightest deviation of the axis of the glass from the meridian which it is desired to correct will destroy the whole effect of the glass.

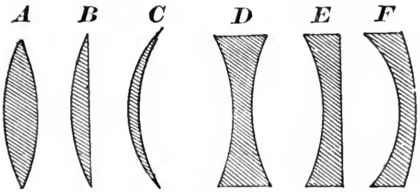


FIG. 36.

Prismatic lenses simply cause a change in the direction of the light rays towards their bases, hence form no images and have no foci. Those used for ophthalmic purposes are confined to some cases of muscular insufficiency and are very weak, two to three degrees, as with the increase of the refracting angle beyond this, the refraction of the rays increases and the diffusion of color becomes a serious inconvenience.

STENOPAIC GLASSES consist of a small portion of transparent glass surrounded by an opaque surface, which prevents the entrance of rays to the eye, except through the narrow slit or circular opening; in cases where the cornea presents many irregularities they may be useful for near vision, but the field being so much contracted by the minute opening they are rarely practical for distance. Protective glasses are usually colored glasses, blue or smoke, with or without refracting curves, as desired. For purposes of protection simply, they should be large enough to well cover the eye, and, if necessary, additional glasses or other material should be supplied to prevent the entrance of light at the side, which is often more annoying than that falling directly upon the eye. The smoke-colored glass is much more suitable than blue glass, which only excludes the orange rays of light which have been

supposed to be particularly distressing to the sensitive retina. Practice fails to prove the peculiar value of blue glasses in the treatment of these cases. The use of protective glasses should not be indulged in more than is absolutely necessary, when the light is not dazzling, as prolonged use tends to increase rather than lessen the sensitiveness to light.

RANGE OF ACCOMMODATION.

If objects are brought nearer than a distance of twenty feet, the rays which fall upon the eye are no longer parallel but divergent, and the refractive power of the media brings them to a focus behind the retina at the conjugate focus. To bring this focus forward, then, so that it will fall upon the retina, the accommodation must be brought into use, which, by increasing the convexity of the anterior surface of the lens, increases the refractive power and shortens the focal distance until the image falls upon the retina and becomes distinct. As in Fig. 37, the upper half of which shows a normal eye in a state of rest, and the lower half in a state of active accommodation for a near point at A.

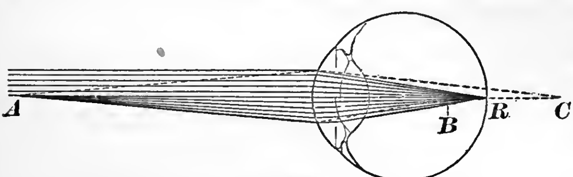


FIG. 37.

The divergent rays from A would be brought to a focus at C behind the retina R if the accommodation was not exercised, but the increased refractive power resulting from the increased convexity of the lens brings them to a focus at R. The point A represents the nearest point of distinct vision and is called the *near point* or *punctum proximum* (P). The greatest distance to which an eye can see is called the *far point* or *punctum remotum* (R). The range of accommodation (A) is the measure of the distance between these two points, and may be expressed by the formula: $A = \frac{1}{P} - \frac{1}{R}$

For convenience this is measured by the power of a lens neces-

sary to produce the same result. In the emmetropic eye this is equal to the distance of the object, measured in inches.

PRESBYOPIA.

During childhood the near point of accommodation is four inches or less, owing to the soft condition of the lens fibres and their consequent increased elasticity. After ten, up to twenty years of age, the lens becomes more firm, and as age advances the accommodative power diminishes, owing to the lessened elasticity of the lens and the loss of power of the ciliary muscle, so that after forty-five years of age objects at less than eight or ten inches from the eye are not clearly focused upon the retina. This shortening of the range of accommodation or receding of the near point is, then, a physiological change which results from age. This loss of accommodative power is called presbyopia (*Pr*). When it has reached a certain degree the amount of accommodation necessary to see an object one foot from the eye is $\frac{1}{12}$, that is $\frac{1}{12}$ of that necessary to see at one inch from the eye. To see an object twenty inches from the eye would then require an amount of accommodation equal to a convex lens of $\frac{1}{20}$. To see at an infinite distance would require one divided by infinity, $\frac{1}{\infty}$ or no effort.

The monocular or *absolute* range of accommodation is that obtained by testing each eye separately; if both eyes are tried together the binocular range is obtained, and this is slightly less than the monocular. The *relative* range is that which we possess when the visual axes of the eyes are fixed upon some near object. The *positive* portion is that lying between the object and the eye and the *negative* that lying beyond the object. The former may be measured by a concave glass, the latter by a convex glass. To exert the eyes for any near work there must always be a reserved amount of accommodation at a given point of convergence, or the eyes tire rapidly. To read comfortably for any length of time the positive portion of the relative range of accommodation must be, at least, one-

half the negative. The power of accommodation in infancy is $\frac{1}{2}$; at ten years $\frac{1}{6}$; at thirty-five $\frac{1}{8}$ or less; at forty-five it is seldom more than $\frac{1}{12}$; at fifty $\frac{1}{16}$; at sixty it is $\frac{1}{24}$.

DIAGNOSIS.—An arbitrary standard of eight inches has been selected by Donders as the near point in the normal eye, hence presbyopia appears as soon as the accommodation falls short of $\frac{1}{8}$, as for fine work that amount becomes necessary. The age at which presbyopia appears depends upon the general condition and upon the shape of the eyeball. If the patient is debilitated, or the eyeball too short, it will appear earlier than if the patient is robust; or, if the eyeball be too long, it will be delayed.

SYMPTOMS.—The symptoms which indicate a condition of presbyopia are first, difficulty in reading fine print with artificial light, followed by a sense of strain in using the eyes for near work at all times. Frequently this condition is accompanied by an irritable state of the eyes and smarting of the lids. These symptoms arise from the fatigue of the ciliary muscle resulting from the effort to maintain the accommodation at a nearer point than its power will permit. If now the range of accommodation is tested, it will be found that the near point has receded eleven or twelve inches. The reason that this condition manifests itself in the evening is because the pupil is more dilated than in daylight, and the larger the pupil the more indistinct objects become when the focus is not exact, as the circles of diffusion become much greater. The eye cannot sustain the accommodative effort necessary under these circumstances without weariness and consequent eye strain, hence the relief to be obtained from the use of a convex glass should not be delayed. In fact, the early use of glasses to relieve the strain, results in giving comfort to the eye, retains the strength of the eye for the future, and, at the same time, lessens the rapid increase of the presbyopia. On the other hand, if the proper glasses are not used, the presbyopia increases more rapidly, and the ciliary muscle is often permanently weakened.

TREATMENT.—No general rule can be given for the deter-

mination of the proper glasses for use, or at what time they should be put on. In prescribing glasses for presbyopia, we must take into account the distance at which the patient is in the habit of using his eyes, and the kind of work for which they are employed. The reading, or sewing distance, varies with individuals according to their habit, stature, and the sharpness of vision. The tall man will read comfortably with his book at twenty inches from the eye, while the small woman finds her needle work in the proper position at eight or ten inches away. The glass obtained, then, by calculation, is not always the practical glass: for example, if the near point is found at eighteen inches, and it is desired to see the object at twelve inches, then $\frac{1}{18}-\frac{1}{12}=\frac{1}{36}$; this, then, should be the glass needed, but a trial with it at 12 inches at once determines that it is not to be worn with comfort, while $\frac{1}{30}$ is, because in this case the positive amount of accommodation at 12 inches is not $\frac{1}{2}$ that of the negative with $\frac{1}{36}$ at that distance, hence it must be increased. Again, the strength of the glass may, according to the individual, have to be diminished, and perhaps $\frac{1}{40}$ would suit much better. Suppose a patient of sixty complains that he can no longer read with comfort, especially in the evening. He reads ordinary print at thirty inches, but not nearer; his former reading distance was fifteen inches, then $\frac{1}{15}-\frac{1}{30}=\frac{1}{30}$; with a $+30$ he reads at the former distance, but finds that the glass does not yet make his reading a pleasure, and on trial a $+24$ is found to suit him perfectly. The rule, then, for the prescription of glasses in presbyopia is to give that glass which makes ordinary print plain at the usual reading distance of the patient, and can be worn with comfort; ordinarily the first glass which is necessary for presbyopia is from $\frac{1}{48}$ to $\frac{1}{36}$ and the change necessary will amount to $\frac{1}{48}$ or $\frac{1}{60}$ for each two years for patients under sixty years of age. After sixty the glass must be changed more frequently, as the increase in the presbyopia is nearly double that of the ten years preceding. It is important to bear in mind that the weakest glasses which enable a person to do his work give him the longest range of accommodation. If the

glasses required are too strong, say $\frac{1}{8}$ or $\frac{1}{10}$, and the accommodation is very much weakened the range of accommodation is necessarily shortened, and patients who wear such glasses are apt to complain because a change of position of the work, or a motion of the head, throws it out of focus. Under these circumstances the patient must be satisfied with the inconvenience, or be content to see at a greater distance with a weaker glass.

The presbyopia of ametropic eyes must be corrected by first correcting the ametropia and then obtaining the near point. In hyperopia, the presbyopic glass is added to that for the correction of the hyperopia. For example, if there is a hyperopia of $\frac{1}{24}$ in a patient of fifty, he requires his near point to be brought up to twelve inches. A convex glass of $\frac{1}{24}$ is placed in front of the eye and a glass of $\frac{1}{48}$ is placed in front of the other glass. If this does not accomplish the result a weaker or a stronger glass may be required; if, however, this is the proper glass, then $\frac{1}{48}+\frac{1}{24}=\frac{1}{16}$, or a convex 16 will be required for near vision.

In myopes, from habit the working distance is close to the eye, and they prefer a glass which will enable them to see at about nine inches. If the myopia is $\frac{1}{6}$, then $\frac{1}{9}-\frac{1}{6}=-\frac{1}{18}$; in this case, the patient would have to use a weaker concave glass for near work. If his myopia was $\frac{1}{9}$ he would require no glass; if $\frac{1}{48}$ he would require, if he desired to work at eight inches, a $+24$; thus $\frac{1}{8}-\frac{1}{16}=\frac{1}{16}$, the amount of presbyopia if the eye was normal, but being myopic the glass then should be $\frac{1}{16}-\frac{1}{48}=\frac{1}{24}$, the convex glass which would give him comfortable vision at eight inches, while the distant vision would still require the use of the concave glass which corrected his myopia.

The failure of the accommodation is not always due to normal causes, but is often an indication of disease, as in glaucoma, where the rapid loss of accommodation is one of the earlist symptoms; also in paralysis of the external rectus muscle, a paretic condition is often observed, and in some cases of beginning cataract there is frequently a rapid failure

of the accommodation. Before prescribing glasses for presbyopia, investigation must decide whether the presbyopia is apparent or real.

HYPERMETROPIA OR HYPEROPIA.

Hypermetropia or hyperopia (H) is a condition in which parallel rays of light are not brought to a focus upon the retina unless the accommodation is brought into use. It depends upon the antero-posterior diameter of the eyeball being too short, less than 23 mm. Under these circumstances the focus of parallel rays is behind the retina, and distant objects are not seen when the eye is at rest. This anomaly of refraction is dependant upon a congenital flattening of the eyeball, and was described by Donders in 1848. In connection with the *congenital* form resulting from the want of proper development, there is frequently a certain loss of vision, or amblyopia, due to the same cause.

Hyperopia may be acquired by diseased conditions or operations upon the cornea which result in flattening of its normal curves. The highest degree of *acquired* hyperopia is that following the removal of the lens in cataract operations or from injury, and also from the physiological changes in the refractive index of the cornea and lens which occur after sixty years of age. Hyperopia presents one of the most common forms of refractive error. In 870 school children examined by the author 523 were found hyperopic, while only 105 presented a normal refraction.

Diagnosis.—In the majority of cases of hyperopia the exercise of the accommodation masks the condition so that careful testing of the distant vision with convex glasses, as well as examination with the ophthalmoscope, becomes necessary to determine the condition. Oftentimes the facial condition of the patient will indicate the probable presence of hyperopia, as the eye appears flatter and smaller, and with this there is an accompanying want of full development of the face, particularly in the malar region, and the nose bridge also frequently presents a flattened condition.

SYMPTOMS.—Patients with hyperopia complain that in reading, writing, and all near work, particularly in an artificial or dim light, the vision, although at first clear, soon becomes blurred, and it becomes necessary to stop work for a time until the eye regains its power. A few moments' rest will enable them to see distinctly again for a short time, when the feeling of fatigue and blur, and perhaps pain over the orbit, again demands rest of the overtaxed eyes. An examination of the eye shows conjunctivitis, palpebral hyperæmia or blepharitis, or perhaps no external appearance of disease is present. Again, the patient avers that there is nothing wrong with the vision, but that the eyes appear weak when he attempts near work, and pain over the brow, severe headaches, or nausea, vomiting, or vertigo, may appear as the result of a strain in the hyperopic condition. As a rule the amount of hyperopia present bears no relation to the amount of accommodative reflex disturbances which arise in these cases, as oftentimes, a high degree of hyperopia gives but slight, if any, inconvenience beyond some general indistinctness of vision and the earlier appearance of presbyopia; whereas in other cases the slightest degrees are often the cause, in less robust and more neurasthenic patients, of severe disturbances. The close application of the eyes for near work, other things being equal, will always hasten the appearance of these symptoms of *asthenopia*, or weak sight, which are either from the weakness of the accommodation, *accommodative asthenopia*, or from weakness of the recti muscles, termed *muscular asthenopia*, which as frequently accompanies the condition.

The cause of these symptoms lies in the unconscious effort of accommodation which the patient is constantly making to increase the convexity of the lens, and thus increase the power to bring the rays of light to a focus upon the retina, instead of behind it, which the defective refraction of the eye would do. By the active effort of the accommodation he is just able to focus the rays so that distant vision is rendered clear, but for all near objects, the rays being divergent, an extra increase of the accommodation becomes necessary, so that during the

waking hours the accommodative apparatus is constantly in use, and consequently soon tires under the continued strain. The effort to perform the extra labor thus thrown upon the ciliary muscle results in hyperæmia of the ciliary body and a generally irritable condition of the eyes, conjunctivitis, blepharitis, etc., and in many cases severe reflex symptoms from irritation of the terminal branches of the ciliary nerves in the ciliary body, simulating cerebral disturbances, not infrequently appear.

The condition of the health and the amount of near application have much to do with the time of the appearance of the symptoms due to hyperopia. If a person has a well-toned muscular system, together with an increased development of the circular fibres of the ciliary muscle, which occurs in this case, as discovered by Iwanoff, he may make no complaint of trouble arising from defective refraction. If, however, the health fails, or, as frequently happens, the complaint follows prostrating fevers, the puerperal condition, mental shock, uterine affections, or the use of the eyes for reading during convalescence or while in a recumbent position, or a constant strain of the muscle necessitated by prolonged work at near or fine objects, as in reading, writing, drawing etc., the power of the accommodation rapidly deteriorates and aid is sought.

Diagnosis.—With the ophthalmoscope, if the mirror alone is used, a rapid diagnosis of hyperopia may be made; the fundus is seen at a greater distance, 18 to 24 inches, than in the opposite condition, myopia, and we have an erect image, which, as in keratoscopy, moves in the same direction as the movement of the observer's head or the rotation of the mirror. In the direct method the fundus is not visible in the close approximation of the eyes, unless the accommodation of the observer is exercised. If the accommodation be relaxed and the observer emmetropic, or a proper correction made, the convex glass rotated into position behind the mirror which gives the distinct vision of the fundus, will give also the degree of hyperopia, when the mirror is brought as close as half an inch from the cornea. If the distance is greater, or

$1\frac{1}{2}$ inches from the nodal point of the observed eye, then the number of the lens of the ophthalmoscope is stronger by the increased distance, represented by a lens equal in focal length to that distance. If an examination at $1\frac{1}{2}$ inches shows a hyperopia of $\frac{1}{8}$, then a lens of 1 in. focus must be deducted, giving the amount of hyperopia as $\frac{1}{7}$ The image recedes the nearer you approach the eye, and at the same time a larger portion of the fundus becomes visible, because the rays from the hyperopic eye are divergent, and the nearer you approach the eye the more rays are obtained by the eye of the observer. The image appears to recede because we estimate the distance by the size of the image. In the indirect method the image is larger, but a smaller portion of the fundus is seen. Here the divergent rays coming from the eye are caught by the object lens, and are brought to a focus further behind the lens and nearer to the eye of the observer, and more rays are collected from the inverted image thus formed.

In the emmetropic eye the vision is disturbed by placing in front of it a convex glass and is not improved by a concave glass, but a hyperopic eye, even if the distant vision as determined by the card of test letters is perfect, will permit the use of a convex glass without disturbance, and if the distant vision be not normal, an improvement follows the use of a proper convex glass. The hyperopic condition can thus be determined in a practical manner by the use of test types and convex glasses. If, then, the patient is placed at the proper distance for the test card, as twenty feet for No. XX, and convex glasses are placed before the eye, the strongest convex glass with which he reads No. XX is the measure of his hyperopia. Thus, if, beginning with a $+\frac{1}{36}$ and following with a stronger glass until $+\frac{1}{24}$ is reached and the print remains or is made distinct, while the next stronger glass blurs the letter, his hyperopia thus determined is $\frac{1}{24}$; this amount of *H* thus discovered is termed manifest hyperopia (*Hm*), and is not usually the full measure, as the ciliary muscle from constant strain does not relax, and the eye still accommodates somewhat even when the convex glass is placed before it. The *H* which thus

remains undetermined is termed latent *Hl* and only becomes known after the ciliary muscle is paralyzed by atropine or some other mydriatic. The strongest glass which then enables the patient to read the test type at the proper distance is the measure of the total amount of hyperopia (*Ht*), and is equal to the sum of the manifest and latent hyperopia. If before the use of the mydriatic the test showed the *Hm* $\frac{1}{24}$ and after the accommodation was paralyzed the *Ht* was $\frac{1}{12}$, then the *Hl* is the difference between $\frac{1}{12}$ and $\frac{1}{24}$, or $\frac{1}{24}$. Usually the *Hl* is greater than the *Hm*, particularly in children and young people. In practice it is not necessary to paralyze the accommodation to obtain the full amount of *H*, as it is approximately determined by the ophthalmoscope, and each eye should be tested separately, and the strongest glass which is borne is the practical measure of the *Hm*. If the glass during the testing is held for a few moments before the eye, the accommodation relaxes somewhat, so that a more accurate result is obtained. The refraction of the two eyes is thus found to differ in many cases and it may be advisable to give the glasses which correct the refractive power of each eye.

Donders, to whom we owe the knowledge of the character and symptoms of hyperopia, makes a further classification of the kinds of hyperopia into facultative, where the patient sees equally well at a distance with or without convex glasses; relative, where distant vision is good without glasses, but is accomplished by a convergence of the optic axes to such an extent as to produce a convergent squint, owing to the relation existing between the accommodation and the convergence of the optic axes; and absolute, where neither distant nor near vision is distinct without convex glasses. This further division possesses no practical importance and is but little used.

In hyperopia advanced age causes the demand for glasses early, at thirty or thirty-five, owing to the gradual impairment of the power of the ciliary muscle; after forty this, together with the loss of the elasticity of the lens, demands the use of a glass to correct the presbyopia as well. In some cases the prolonged tension of the ciliary muscle in its efforts to respond

to the frequent calls made upon it, results in the production of a spasmodic contraction of the muscle which causes spasm of the accommodation. This condition occurs more often in weak degrees of hyperopia, as $\frac{1}{60}$ to $\frac{1}{36}$, and may mask the true condition by simulating myopia, and the use of convex glasses will be refused, while a weak concave glass is worn at the expense of still greater tax upon the accommodation. This condition will be more fully considered in the affections of the ciliary muscle. Hyperopia is the common cause in the production of convergent strabismus, since the act of accommodation is associated with contraction of the internal recti muscles, and can only be exercised to a limited extent without converging the optic axes, and as the ciliary muscle is in a state of constant contraction, which must be still more increased for near objects, an increased convergence by the recti is brought about until the patient converges more than is necessary to fix the eyes upon the object, and as he can no longer see with both eyes, one or the other deviates inward, while the other fixes upon the object accurately. In time this temporary deviation becomes fixed and convergent strabismus results.

TREATMENT.—The treatment of hyperopia consists in the prescription of convex glasses to correct in whole, or in part, the error of refraction, and thus relieve the ciliary muscle of the necessity of extra work. Fig. 38 represents a hypermetropic eye at rest, in which condition the convergent rays AA are refracted to a focus upon its retina H, parallel rays BB being under the same condition refracted to a focus at the normal position of the retina E; by the interposition of a convex lens the parallel rays are rendered convergent and thus enter the eye in such a condition as permits the formation of a distinct image upon the actual retina H. The power of the lens

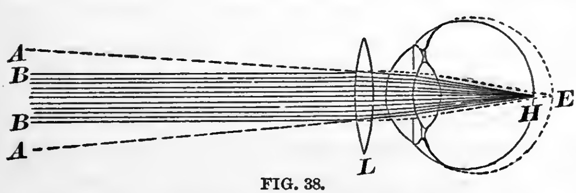


FIG. 38.

required, and the necessity for wearing it at all times, or only for near work, will depend upon the individual peculiarities of each case. In some cases where the vision is acute for both near and distant objects the accommodation does not seem to suffer from the prolonged tension. Here glasses may not be needed until the age of thirty or thirty-five, when the early appearance of presbyopia, as denoted by the removal of the near point beyond ten or twelve inches, will require a convex glass for reading. The convex glass which corrects the whole of the *H* would seem theoretically to be the glass to be worn, but practically this glass is too strong, as the ciliary muscle seems to have acquired a certain amount of tension which does not relax under the use of the glass. Hence the rule is to give that glass which corrects the whole of the manifest *H*, and a part, usually one-fourth, of the latent. The patient is asked to read No. XX of Snellen's test types at twenty feet distant; he does so readily. Now place before the eyes a weak convex glass, say $\frac{1}{48}$, and if the letters still remain clear try a still stronger one until we find he reads the test with $\frac{1}{30}$; trying the next glass we find that it blurs the vision somewhat. We have determined that his *Hm* is $\frac{1}{30}$; he is then asked to read No. 1 test type at twelve inches with this glass; if he can do so with facility he is given this glass, a convex 30, which he is directed to use for all near work. Tested with the ophthalmoscope his *H* is found to be $\frac{1}{18}$; we have then corrected only part of his error. Now the glass prescribed may relieve his symptoms entirely, or it may be necessary for him to wear the glasses constantly for both near and distant vision. If the latter becomes necessary, then he will be required to change the glasses for stronger ones in a short time as they do not neutralize his latent hyperopia, and this will gradually become manifest, and his asthenopic symptoms will again appear and require a stronger glass. These changes will have to be repeated until after a few months the whole amount of *H* becomes manifest and is corrected.

In children it is better to correct the full amount as determined by the ophthalmoscope, or under the paralyzing effect

of atropine, as the vision, which is often poor in these cases, seems to improve from the apparent improvement in the tone of the eye resulting from the use of the glasses. In adults the correction of the whole amount as determined by these methods causes too much inconvenience. If in the test the distant vision is not acute but made so or improved by the convex glasses, then the full amount of *H* should be corrected and the glasses ordered to be worn constantly as a rule. The glasses should be continually worn in all cases where the *H* is more than $\frac{1}{12}$ and in weakly subjects where it is even less than this, particularly if the recti muscles are weak. With the appearance of presbyopia, the patient will have to use two pairs of glasses, one for distance which corrects his hyperopia and a stronger one for near vision, which corrects both the hyperopia and presbyopia. In many cases of *H*, particularly of high degree, the vision is not made acute by any glasses, a certain amount of congenital amblyopia being present from the undeveloped condition of the eye. In many cases the asthenopic symptoms occasioned by the over-strained and often irritable ciliary muscle do not subside upon the prescription of glasses, but will require some medicinal treatment.

MYOPIA.

Myopia (*M*) or nearsightedness is a condition exactly the opposite of hypermetropia, the eye being too long, or more than 23 mm. in its antero-posterior diameter. Hence, parallel rays, when the eye is in a state of rest, are brought to a focus in front of the retina. If the accommodation is exercised it serves only to bring the focus of the rays still further in front of the retina. The far point of the myopic patient must then approach closer to the eye, as an object to be perceived must be nearer to the eye than infinity, or twenty feet, so that the rays will be divergent instead of parallel. The far point will thus approach nearer and nearer to the eye as the degree of myopia increases. Myopia is occasionally physiological or congenital. More frequently the tendency is

inherited, but it is commonly acquired, and, except in very slight degrees, is progressive with age. The stronger the degree of myopia the more liable it is to increase, especially between the ages of twelve and twenty-five years. The eye-ball is usually more prominent, from its egg-like shape, and its movements more impeded than in the emmetropic or hyper-metropic eye, and when the eye is directed inwards the outer canthus is filled by the lengthened eye-ball. The pupils are usually more dilated than in the normal eye, and when trying to look at distant objects the eyelids are partially closed, thus lessening the circles of diffusion on the retina and giving more distinct vision.

Causes.—The causes which give rise to myopia are, as yet, not fully understood. While it may be congenital, the tendency is often hereditary. It is most frequently acquired between the ages of seven and fifteen, very rarely appearing after twenty-five years of age. It is a diseased condition of the eyes occurring in childhood and early adult life, seldom increasing after twenty-five, unless from want of proper hygiene of the eyes, prostrating illness, general enfeeblement of the health and loss of tone of the muscular system. If the sight in childhood is imperfect from any cause, such as opacities of the cornea and lens, choroidal disease or astigmatism, myopia is induced from objects being brought close to the eyes to obtain a larger image upon the retina.

Myopia may be caused also by an increase in the refractive power of the lens or cornea. If the cornea becomes more convex, as in conical cornea, the focal point lies in front of the retina. In commencing cataract, a swelling of the lens or an increase in its refractive power causes a certain degree of myopia, as also does spasm of the ciliary muscle, which produces and maintains an increased convexity of the lens.

The more frequent causes which determine the inception and progress of myopia are those arising from prolonged use of the eyes in looking at objects held a short distance away. The constantly increasing proportion of myopes among school children and students shows that defects in our educational

system have much to do with its origin and progress. The arrangement of the light and desks, the posture, etc., of the child or student, increase or lessen the tendency to this disease. The flickering, dull or otherwise poor light, or that coming from the side so as to throw a portion of the page in the shadow; the lowness of the desk which requires a bent position upon the part of the child; reading in the prone position, or after a hearty meal; the imperfect print of text-books, or the difficult characters of music, Greek or German, with many others, are highly productive of many cases of myopia.

The effect produced upon the eyeball which results in the elongation of its axis is explained upon the ground that all close application of the eyes is accompanied by an increase in the ocular circulation, and if the return flow is interfered with by the position of the head while stooping over the book or work, choroidal congestion with increased intra-ocular tension results. This causes a predisposition to the softening of the choroid and sclera. Together with this, the effort to fix the eyes upon close objects is accompanied by strong efforts at convergence and accommodation. This produces pressure upon the eyeball by the tension of the internal rectus, which is counterbalanced by the external rectus, and the fluid pressure is transmitted to the posterior portion of the eyeball, which is unprotected, and a slight bulging of the sclera at this point results. If these efforts are prolonged and rapidly recur and the sclera is correspondingly weak, the stretching becomes permanent, and although the eye may have been originally emmetropic, or slightly hypermetropic, it may thus become myopic. It is evident that if the disease once be started it will tend to rapidly increase the lengthening of the eyeball and the degree of myopia. The proportionate elongation of the optic axis to the degree of myopia has been tolerably well determined by Loring and others and is as follows: an elongation of .22 mm. produces a myopia of $\frac{1}{50}$; .27 mm. of $\frac{1}{40}$; .37 mm. of $\frac{1}{30}$; .46 mm. of $\frac{1}{24}$; .56 mm. of $\frac{1}{20}$; .63 mm. of $\frac{1}{18}$; .82 mm. of $\frac{1}{14}$; .97 mm. of $\frac{1}{12}$; 1.06 mm. of $\frac{1}{11}$; 1.17 mm. of $\frac{1}{10}$; 1.31 mm. of $\frac{1}{9}$; 1.5 mm. of $\frac{1}{8}$; 2.07 mm. of $\frac{1}{6}$; 2.56 mm. of $\frac{1}{5}$;

3.34 mm. of $\frac{1}{4}$; 4.81 of $\frac{1}{3}$; 8.61 mm. of $\frac{1}{2}$. Very slight degrees of myopia are thus seen to be attended by an apparently insignificant increase in the length of the eyeball, only .5 mm. up to $\frac{1}{24}$. The effect, however, has been a serious one to the patient, as his far point has been brought from infinity to within twenty-four inches of the eye. As the elongation of the eyeball increases, the far point rapidly approaches the eye, as in a myopia of $\frac{1}{3}$ the eyeball is lengthened 5 mm. or $2\frac{1}{2}$ lines, and the far point is now but three inches from the eye. In some cases the myope may derive some compensation from the fact that he sees more distinctly and works at a closer range with more comfort than an emmetropic eye, because he does not use his accommodation; but, contrary to the popular idea, the myopic eye is not a strong eye, but a diseased one, and but few of its many subjects ever have even the satisfaction of comfortable near work.

THE PATHOLOGICAL CHANGES

in the choroid, sclera and retina become apparent even in the slighter degrees of myopia, as we frequently find them in $\frac{1}{10}$ or less, while they become much more manifest and more grave with each additional degree of elongation. These changes consist in a stretching of the sclera, choroid, and retina, and a consequent atrophic condition of the delicate tissues of the latter. The sclera is expanded and thin throughout its whole extent, on the temporal more than on the median side, and more markedly at the posterior pole than elsewhere, as shown in Fig. 39, which represents a section of a strongly myopic eyeball with posterior bulging. These changes affect particularly the optic nerve entrance, causing a displacement of the optic nerve somewhat to the nasal side. A separation of the two nerve sheaths takes place in close proximity to the optic nerve entrance, as the outer sheath

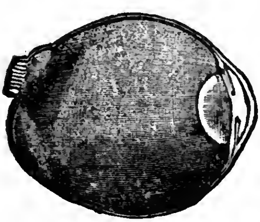


FIG. 39.

is continuous with the outer portion of the sclera, the inner sheath being closely united to the nerve. The subarachnoidal space becomes much wider and the posterior portion of the eyeball presents a conical appearance. The thinned sclera sinking into this space constitutes the so-called *posterior staphyloma*, which becomes very apparent in high degrees of myopia. The anterior portion of the choroid remains normal, but as it approaches the expanded portion it becomes thinner and atrophied. There is in the majority of cases a slow inflammatory condition of this portion of the choroid, which has been termed *sclerotico-choroiditis posterior*. This results in the thinning of the portion of the choroid adjacent to the optic disc, until it appears as a transparent membrane devoid of blood-vessels and capillaries, so that the white underlying sclera becomes visible. This choroidal atrophy may present the appearance of a crescent about the optic disc as in Fig. 40, and usually appears on the temporal side, and, extending towards the macula lutea, gives to the optic disc a jagged and irregular appearance.

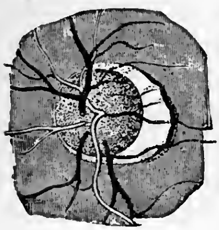


FIG. 40.

In high degrees of myopia the atrophic portion encircles the whole optic disc as in Fig. 41, and gives to it a much larger appearance than normal. If the myopia progresses rapidly other portions of the choroid become involved in the inflammatory process, and atrophic patches result; or the vitreous becomes involved and opacities of varying size appear, which interfere with the vision of the patient; or the vitreous itself may become fluid. If the opacities are very fine and diffuse, the patient will be annoyed by the *muscæ volitantes* which myopic patients frequently complain of, although no impairment of the vision results. These floating specks often indicate an increase in the myopia. If the opacities are larger or float through the liquid vitreous,

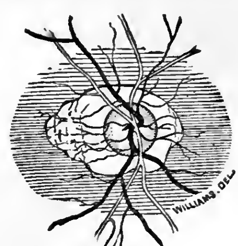


FIG. 41.

they interfere very materially with the vision. The retina, in participating in the choroidal stretching, lessens the visual acuity by the disturbance of its elements. The rods and cones being stretched apart occasion breaks in the outline of objects, a condition termed *metamorphopsia*, and the retinal vessels also become more prominent and straighter in their course. Being loosely attached to the choroid, the retina is liable to detachment, particularly in high degrees of myopia, when its natural support, the vitreous, is lost by the changes which take place in it. This forms one of the most grave complications arising in myopia. Other changes which result from this disturbance are retraction of the iris, lens and anterior portion of the ciliary body, the deepening of the anterior chamber in myopia being thus accounted for. The nutrition of the lens may also be affected, and cataract, usually beginning at the posterior pole, follows. These results arising from the diseased condition of the eye, render the early recognition of myopia and its proper treatment of the utmost importance to the patient as regards his future vision, as these changes frequently develop after slight injuries, prolonged use of the eyes in reading or in near work, and the use of improper glasses, and again arise without apparent cause and progress until the vision is partly or completely lost.

The symptoms which accompany these changes may be very slight; there is usually, however, more or less sensitiveness to light, which may increase to such a degree as to demand entire exclusion of light from the eyes. The eye presents an irritable appearance, and intense pain may accompany its use, though more frequently the pain is described as of a dull, aching character, and is often referred to the orbit.

Diagnosis.—The diagnosis is readily made by testing the far and near points of vision. If the patient cannot see distant objects and can read No. 1 Jaeger or $1\frac{1}{2}$ Snellen of the small types well, but not beyond eight inches, this is evidently his far point, and if he cannot read the ordinary test types for distance, a concave glass is tried and the weakest concave glass

with which he gets the best vision is the measure of his myopia; thus, if he cannot read the test type without a glass, but can do it with a concave $\frac{1}{8}$, then his myopia is $\frac{1}{8}$; or, if the removal of the glass somewhat from the eye does not lessen the vision, the glass is then too strong and a weaker one must be tried. If, however, this glass seems to suit the different objects, he is myopic $\frac{1}{8}$, and a concave $\frac{1}{8}$ placed in front of such an eye will cause parallel rays to be divergent as if they came from a distance of only eight inches, and would thus make distant objects distinct.

The ophthalmoscope affords a ready and accurate method of diagnosing this trouble. If the mirror is used without the lens at eighteen inches or two feet from the patient, an inverted image is seen which moves in an opposite direction to the movement of the head of the observer. This is due to the crossing of the emergent rays before they meet his eye. If now the mirror is brought close to the eye, the weakest concave lens which will show the smallest retinal vessels near the disc will give the degree of myopia, provided the observer's accommodation is relaxed. The change in the fundus which is discoverable by the ophthalmoscope, is the choroidal atrophy about the optic nerve, as already stated. This is usually crescentic and on the temporal side, but may appear on the other side, or encircle the whole disc.

In keratoscopy the image of light and shade moves in the same direction as that in which the concave mirror is rotated, and the rapidity of movement and curvature of the shadow are the same in all meridians in cases of simple myopia.

Treatment.—The treatment of myopia should be both prophylactic and palliative or corrective. In the *prevention* of myopia and lessening of its progress much may be accomplished by the proper care of the eye. There is no doubt that myopia is produced, or at least greatly increased in school children by want of proper arrangement of the light, the height of the desks, and the print of text-books. The light should be good, the seats so arranged that the light comes from the left, and the desks of such a height as to remove the

temptation to stoop. Reading or writing in a dull or flickering light must not be permitted, and the amount of reading must be regulated, as this class of cases are apt to consume time in reading which should be used for developing the muscular system. Where a myopic tendency has been exhibited in children who have suffered from exanthematous diseases, reading and attendance at school should not be allowed until full bodily strength has been restored. Where vision is defective from astigmatism, or spasm of the accommodation is present, the correction by proper glasses should be made. In reading, the book should be held as far from the eye as possible and yet allow of distinct vision, and when the eye tires, the book should be laid aside and the eyes rested. In cases where the trouble is progressive and there is much choroidal congestion, the use of the eyes should be stopped until the condition improves.

Atropine, by paralyzing the ciliary muscle, may prevent the rapid increase of myopia where it is accompanied by spasm of the accommodation. Such remedies as Agaricus, Belladonna, Gelsemium, Physostigma, Jaborandi, Lilium tigrinum and Duboisia, when properly prescribed, do much towards improving the condition of the myopic eye by correcting the irregular action of the ciliary muscle. Other secondary disturbances of the optic nerve, retina, and choroid should be combatted by such remedies as Belladonna, Phosphorus, Gelsemium, Macrotin, etc.

The *palliative* treatment consists in the use of proper concave glasses to correct the error of refraction. The manner in which concave glasses correct the error of refraction is readily explained by reference to Fig. 42, which represents a myopic eye in a state of rest, and rays from its far point *B* are brought to a focus upon the retina at *M*. Parallel rays *A A*, however, are refracted to a focus at *E*, the position of the retina of an emmetropic eye, and in front of the myopic retina. If now the proper concave lens is placed upon the eye the rays *A A* are rendered convergent, and enter the eye in same direction as if coming from *B*, and are thus

converged upon the retina at *M*. In mild degrees of myopia without tissue change, the weakest glass which gives clear vision of distant objects may be worn without danger, and have no effect upon the progress of the myopia. In all cases where the myopia is less than $\frac{1}{12}$ the glasses should not be worn for near vision. In higher degrees than $\frac{1}{12}$, the glasses may be worn for near vision, as they remove the near point farther from the eye and thus lessen the convergence of the eyes and the tension of the recti muscles, so that patients are no longer tempted to stoop. These glasses must be weaker than those which are used for distance, from the fact that glasses which correct the whole myopia would require the exercise of the full accommodation for near objects, and as the accommodation is usually weakened, the effort would only lead to overstraining and thus increase the trouble. If a patient with myopia reads No. XX test type with $-\frac{1}{12}$, the weakest glass which makes the print clear, and it is desired to adapt glasses for reading music, sewing, or other special work at a distance of two feet, then the glasses desired will be $\frac{1}{12}-\frac{1}{24}=\frac{1}{24}$. If the myopia is $\frac{1}{6}$, the far point then is only six inches from the eye, and glasses will be required which will enable him to read at twelve inches; then $\frac{1}{6}-\frac{1}{12}=\frac{1}{12}$ will be the glasses required. Each eye should be tested separately, and when one eye is more myopic than the other, the least myopic eye decides the number of the glass. If different glasses are prescribed for the two eyes, the images formed upon the two retinæ differ in size and cause confusion.

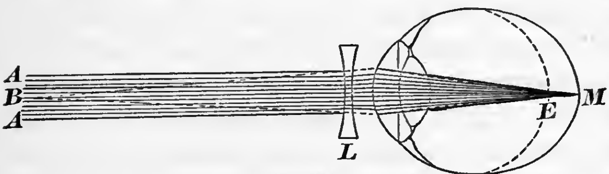


FIG. 42.

The same glasses may be worn for both near and distant vision when the myopia is slight, the range of accommodation good, and the eye perfectly healthy. Glasses for near vision may also be given when the myopia is great, to prevent the convergence of the optic axes and lessen the tension of the

accommodation, and also where there is much asthenopia. Glasses should not be allowed in mild degrees of myopia, say $\frac{1}{40}$ to $\frac{1}{36}$, either for distant or near vision, particularly in young persons. Where necessary, a glass may be given to be used occasionally for distant vision. Glasses should also be forbidden where there is much amblyopia, as in cases where there are extensive changes in the sclera and choroid. Muscular asthenopia from insufficiency of the internal recti muscles is a common accompaniment of myopia, and if not relieved by the use of proper concave glasses and such remedies as Argentum nitricum, Gelsemium and Merc. peren. may require tenotomy of the external rectus of one or both eyes, particularly if the weakness is sufficient to cause a divergent squint. Prismatic glasses, the bases of the prisms being turned toward the nose, are serviceable in some cases to relieve the aching from muscular insufficiency, and may be used separately or combined with the concave glass. The light in passing through the prism is refracted towards its base and thus gives the rays from a certain near point, a direction as if they came from a greater distance, and thus lessens the necessity for convergence of the optic axis.

As the myopic patient advances in life, if the myopia has been of moderate degree, he is enabled to work without glasses where other persons with emmetropic eyes require the use of convex glasses. In the higher degrees, the physiological decrease of the power of the lens may require, however, a weaker concave glass for near vision, while the patient will retain his former glasses for distance. He may even require concave glasses for distant vision and a weak convex glass for near vision. These may be combined by grinding the upper part of the lens for distance and the lower part for near vision, forming the so-called glasses of double focus or pantoscopic glasses.

ASTIGMATISM.

Astigmatism (*A*) is that condition of the refraction of the eye where the rays are not brought to a distinct focus, the

image of a luminous point appearing, not as a point upon the retina, but as an elongated oval, or luminous line. It is due to the fact that the curvature of the cornea is not the same in every direction. In the normal eye there is a slightly greater curvature of the vertical than of the horizontal meridian of the cornea, and when the optical effect of this difference becomes perceptible astigmatism exists. In case the horizontal meridian has a normal curve of 31 mm. and the vertical meridian presents a shorter curve of only 28 mm., then the horizontal meridian will be emmetropic, and the rays of light passing through it will be brought to a focus upon the retina, while the vertical meridian will be myopic and the rays be focused in front of the retina. The distance between these two focal points gives the degree of astigmatism. The image thus formed upon the retina will not be distinct, but blurred and distorted. Astigmatism, then, depends upon a difference in the curvature of the meridians of the eye. The vertical, horizontal, or intermediate meridians do not present a perfectly spherical curve, or one of these meridians may be more convex than the others.

CAUSES.—This irregularity is usually congenital and hereditary, but may be acquired after injuries, or operations involving the cornea, such as cataract extraction or iridectomy. Some cases, however, are undoubtedly due to similar conditions of curvature in the meridians of the lens, which may arise from the irregular action or spastic contraction of certain fibres of the ciliary muscle.

Astigmatism due to difference in the curvature of sections of the cornea is termed *regular*, and is susceptible of correction by cylindrical glasses, while that condition where irregularities in the curve of single meridians occur from injury or disease of the cornea, such as ulcerations, or from displacement of the lens, is called irregular astigmatism. *Irregular* astigmatism sometimes causes two or more images in one eye, or monocular polyopia. It arises from irregularities in the cornea, or in the structure of the lens. The emmetropic eye may have a certain amount of irregular astigmatism caused by

variations in the different sectors of the lens. The vision in this class of cases is improved by looking through a small opening in an opaque disk, but cannot be wholly corrected by glasses, although slight improvement is gained by the trial of concave or convex lenses.

In regular astigmatism the two principal meridians, that of the greatest and that of the least refractive power, are at right angles to each other, or nearly so, and the one having the greatest refractive power is usually the vertical.

If one meridian is normal the retina is at the proper focal distance and the eye is emmetropic in that meridian, but ametropic in the other. In this case the astigmatism is *simple.* If one meridian is emmetropic and the other myopic, or of greater curvature, then myopic astigmatism is present (Am), or if one is emmetropic and the other hypermetropic, or of less curvature, then it is a case of hyperopic astigmatism (Ah).

In *compound* astigmatism both principal meridians are ametropic, each being myopic, one with a greater curvature than the other, thus producing compound myopic astigmatism ($M+Am$), or both may be hypermetropic, forming compound hypermetropic astigmatism ($H+Ah$). While simple astigmatism requires only a cylindrical glass for its correction, compound astigmatism requires a spherical glass combined with a cylindrical glass to improve vision; a convex spherical combined with a convex cylindrical in compound hypermetropic astigmatism, and a concave spherical combined with a concave cylindrical in compound myopic astigmatism.

Mixed astigmatism is that variety in which one meridian is myopic and the other hypermetropic, and is the most difficult to determine accurately, requiring for correction the combination of a concave cylindrical with a convex cylindrical glass, which are generally ground at or near right angles to each other.

SYMPTOMS.—The symptoms which arise from astigmatism are usually those of indistinct vision for both near and distant points. Objects often appear distorted, the distortion occurring more frequently in the direction of their height. The

announcement is frequently made that horizontal lines are more distinctly seen than vertical ones, or that certain figures on the dial of a clock or watch are seen distinctly, while others are much less so. It is not uncommon for some patients affected with astigmatism to be able to overcome their defect by means of accommodative effort. If this power fails, then the vision becomes more imperfect, and they also complain of asthenopia resulting from the overstrained accommodation. Again, this tension of the accommodation results not infrequently in the production of severe headaches, which sometimes exist for years, resisting all forms of treatment, until the adaptation of a pair of cylindrical glasses gives good vision, comfort to the eyes, and relief from the headaches, at once. Other more obscure reflex nervous symptoms, such as chorea and neuritis, have disappeared upon the correction of the astigmatism. Conjunctival irritation and chronic blepharitis, which resist treatment until proper glasses are prescribed, are also frequent accompaniments of astigmatism. It is frequently associated with high degrees of hypermetropia and myopia, and causes asthenopic headaches as well as lessens the already defective vision.

Diagnosis.—There are many methods of making a diagnosis of astigmatism, and of determining its degree, and all possess some merit in individual cases. The most rapid way is to test the acuteness of vision by the test type, and, if below normal, then examine the eye with the ophthalmoscope, and a glance will suffice to determine whether the case is hypermetropic or myopic. If it is astigmatic the optic disc, in the direct method with the erect image, will be oval or elongated, the elongation corresponding to the meridian of greatest curvature, which is usually vertical or nearly so. The disc, or the vessels upon certain portions of it, will be more or less indistinct. The retinal vessels, however, form the best tests, as they emerge in a radial direction from the disc and appear less distinct in some portions than in others, and it is possible to determine the meridians which are defective, and whether they are hypermetropic or myopic, and possibly the degree, from their appearance.

In the indirect method the disc is also elongated, but, the image being inverted, the elongation is at right angles to that in the direct method. If the object lens of the observer is moved nearer to or further from the eye there is an apparent rotation of the disc, the change being seen in the long axis of the oval, which, from being vertical, becomes horizontal when the lens is held nearer to the eye than its focal length, and as it is withdrawn the disc appears round and then oval vertically. The size of the image varies according to the general refraction of the eye; if emmetropic, there is no change, if myopic the image increases, if hypermetropic, it diminishes.

In testing the eyes for astigmatism, we proceed at once to test the eyes separately for myopia or hyperopia with concave or convex lenses. If the vision is not made normal by the use of these glasses, or the patient persistently miscalls certain letters of the test types, or sees better when the glasses are tilted before the eyes, then a stenopaic slit, a narrow slit $\frac{1}{25}$ of an inch wide in a brass disk, set in a trial frame, is placed before the eye, and as the long axis of the slit is rotated before the eye, vision will probably be improved in the meridian in which there is the least defect, and concave or convex glasses in front of the slit will indicate the probable astigmatic refraction in that meridian. The slit is then turned 90° and a fresh correction made if necessary. The astigmatism may be determined by means of the various test cards devised by Snellen, Carter, Green, Pray and others, all depending upon the fact that when an astigmatic eye looks at a number of lines drawn in different directions, some appear more distinct than others. One of the simplest diagrams, and as useful as any, is that presented in Fig. 43, consisting of a fan of equal narrow black rays. If a patient has a myopia of $\frac{1}{36}$ in the vertical meridian, and the other meridian is normal, he will see the horizontal lines distinctly and the others will be somewhat blurred. He has then simple myopic astigmatism, and a concave cylindrical glass of $\frac{1}{36}$ inch focus with the axis vertical will make all the lines equally distinct. If, again, he is myopic, say $\frac{1}{30}$, in the horizontal meridian, the vertical lines will be most distinct

and a concave cylindrical glass of $\frac{1}{30}$ with the axis horizontal, (?) will correct the trouble. If it is a case of simple hyperopic astigmatism of the vertical meridian, the vertical lines will appear the most distinct. By placing the proper convex cylinder before the eye, with the axis horizontal, the defect is corrected. If the horizontal meridian is hyperopic the horizontal lines will be the ones most clearly seen, and the cor-

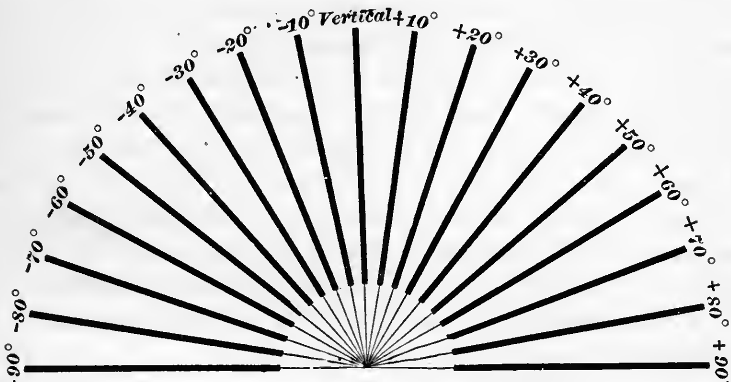


FIG. 43.

recting glass will be a convex cylinder with the axis vertical. The rays passing through the horizontal meridian will be converged by the lens and brought to a focus upon the retina, while the rays passing through the vertical meridian, not being altered by the glass, will still be focused upon the retina.

In compound astigmatism we correct the myopia or hyperopia as if no astigmatism was present, and then proceed as above to correct the astigmatism, using a spherico-cylindrical glass for the purpose. The two principal meridians are sought out and tested separately by cylindrical glasses. If, for instance, we have a myopia of $\frac{1}{20}$ in the vertical meridian, and a myopia of $\frac{1}{10}$ in the horizontal meridian, then a certain amount of myopia is common to both meridians, and amounts to the difference between them, as $\frac{1}{10}-\frac{1}{20}=\frac{1}{20}$; there is present then a myopia of $\frac{1}{20}$, which will require a concave spherical glass of $\frac{1}{20}$. This will correct the myopia of the vertical meridian and also leave a myopia of $\frac{1}{20}$ in the horizontal

meridian to be corrected. The glass then required would be a —20 s. combined with (⊃) —20 c., axis vertical. If, again, we find that the vertical meridian is hypermetropic, say $\frac{1}{15}$, and the horizontal meridian $\frac{1}{30}$ hypermetropic, then it is a case of compound hyperopic astigmatism and the glasses required will be +30 s. ⊃ +30 c. axis horizontal, which should make all lines perfectly clear.

Cases of mixed astigmatism are less common than the other forms and much more difficult to determine, and require a great deal of time and patience in conducting the test, demands which are made upon the surgeon with all cases of astigmatism. Astigmatic patients mean well, but their inability to define objects properly has not prepared them to answer correctly, and the result is unsatisfactory, notwithstanding their anxiety to be accurate. Hence repeated examinations have to be made, and results compared, before anything satisfactory has been accomplished. Where much difficulty has been experienced the use of atropine, duboisia, or homatropine should be employed to paralyze the accommodation, which becomes a mischievous factor in the examination. The effects of all these mydriatics are unpleasant to the patient from the glare of light which is admitted to the eye by the dilated pupil, and the consequent loss of the accommodation prevents the patient from reading, writing and all near work for some days afterwards. I prefer the hydrobromate of homatropine, two grains to the fluid dram, in these cases, two or three drops producing complete paralysis of the acommodation within an hour. The paralysis lasts only about an hour, the eye frequently returning to its normal condition in thirty-six hours. Either this or atropine should be used in all cases of myopic and mixed astigmatism, as oftentimes an apparent myopic astigmatism becomes an hyperopic astigmatism under the influence of the mydriatic or even a case of simple hyperopia or myopia.

In cases of mixed astigmatism, one meridian being hyperopic and the other myopic, the test cards which present a full circle of radiating lines are necessary, and the correction is

made by two cylindrical glasses which are usually placed at right angles to each other in the defective meridians. For example, if the vertical meridian presents a myopia of $\frac{1}{16}$ and the horizontal a hyperopia of $\frac{1}{10}$, then cylindrical glasses are prescribed and the prescription is written **10 c** ⌈— 16 **c** axis horizontal. If the defective meridians are other than those indicated, then the angles at which the glasses are to be ground are indicated on the optician's blank, which corresponds with the graduation of the trial frames.

In regard to the prescription of glasses for astigmatism, if it is simple the full correction may be prescribed at once, and may be worn either for reading or distance, or both, as the individual cases may demand. If compound, the correction of the astigmatism must be fully made, while the use and degree of the glass for myopia or hyperopia must be determined by the rules governing the prescription of such glasses as already described. If the astigmatism is mixed, the full correction is to be given for distance, and probably for near vision also, though the latter is to be decided by the comfort of the patient. If there is much amblyopia the weakest glass, concave or convex, which gives the best vision should be prescribed.

In some cases different cylinders will be required for near vision than those for distance. This is more frequently the case in simple astigmatism, and a patient may require a convex cylindrical glass for distant, and a concave cylindrical in the same meridian for near vision.

When astigmatics become presbyopic the cylindrical correction is to be added to the presbyopic glass.

ANISOMETROPIA.

This is a term applied to cases where the refraction of the two eyes is dissimilar. One eye may be hyperopic and the other emmetropic, or one may be emmetropic and the other myopic, in which case the former is used for distant and the latter for near vision. It is not usual to give glasses in these

cases, as the vision is monocular, and the glasses would cause a difference in the size of the retinal images, and in producing binocular vision cause such disturbance in the accommodative effort that the use of the eyes would become extremely irksome. In some cases the correction may be attempted, but if the glass is not worn comfortably, it should be abandoned. This condition is a frequent cause of strabismus.

CHAPTER VI.

AFFECTIONS OF THE MUSCLES.

ANATOMY.

The muscles of the eyeball are of two classes, the *intrinsic* or *internal*, those of the iris and ciliary body, and the *extrinsic* or *external*, those which produce the movements of the eyeball itself. The extrinsic muscles are six in number, four recti and two oblique (Fig. 44). The recti or straight muscles arise from a tendinous ring around the optic foramen and passing forward are inserted into the anterior portion of the sclera at equal distances from each other by expanded tendons. These tendons form a fibrous expansion which encircles the circumference of the globe; before insertion into the sclera, they pierce the tunica vaginalis of the globe, dividing it into an anterior portion, Tenon's capsule, and a posterior part, the capsule of Bonnet. The insertions are not all at the same distance from the corneal border, the insertion of the internal rectus being nearest to the sclero-corneal junction, about 5 mm. distant, while the inferior rectus joins the sclera at 6 mm., the external at 7 mm., and the inferior at 8 mm., from the cornea. These varying distances are to be remembered in making a tenotomy of these muscles. The recti muscles also present variations in their length, the internal being shortest and the external longest. Three of the recti, namely, the superior, inferior and internal, are supplied by the 3rd nerve, while the external derives its nerve supply from the 6th, or

abducens. The blood supply is derived from the muscular branches of the ophthalmic artery, which give off in the tendons the anterior ciliary arteries. The two oblique muscles, the superior and inferior, present a different origin, course and nerve supply; the superior oblique takes origin with the recti muscles, but passes forward to the upper and inner angle of the orbit, there passing over a tendinous pulley, and turns outward and backward, and is inserted by a broad, fan-like tendon into the outer side of the ball behind the equator. It is supplied by the 4th, or trochlear, nerve.

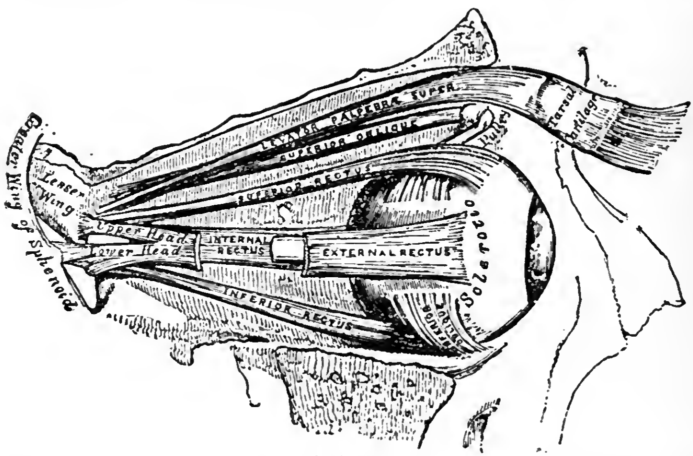


FIG. 44.

The inferior oblique arises from the superior maxillary bone on the inner floor of the orbit, and passing backward, is inserted on the outer side of the posterior half of the eyeball opposite the insertion of the superior oblique, with the external rectus lying between them. It is supplied by a branch from the 3d nerve. The two oblique muscles serve to suspend the eyeball in the orbit as well as to give it motion.

The combined action of the recti muscles results in the retraction of the eyeball into the orbit, while a similar action of the oblique muscles draws the globe forward. In the complex movements of the eyeball the muscles are grouped together in twos or threes for the movements in various directions, and

each group during action is opposed by a similar group. In the action of the muscles separately, the internal rectus turns the eye directly inward and the external directly outward. The superior and inferior recti turn the eye upward or downward, but, owing to the fact that the origins of the muscles are nearer the median line of the head than their insertions, they also turn the eye somewhat inward. In order, then, to turn the eye directly upward or downward the action of the superior or inferior oblique must be added. The superior oblique turns the eye downward and outward and at the same time produces a partial rotation of it from above downward, thus inclining the vertical meridian of the cornea inward. The inferior oblique rolls the eye upward and outward and rotates it from above downward. For looking in intermediate directions, as upward and inward, or downward and inward, a combined action of a group of three muscles is required. This compensatory action of these additional muscles also preserves the proper position of the vertical meridian of the cornea, which would otherwise be drawn too far inward or outward and thus disturb the vision. In the normal action of the muscles, the eye is turned inward by the internal rectus; outward by the external rectus; upward by the combined action of the superior rectus and inferior oblique; downward by the inferior rectus and superior oblique. In the motion of the eye diagonally upward and inward the rectus superior acts in combination with the rectus internus, and is further controlled by the inferior oblique in directing the eye upward and outward. The rectus superior and the rectus externus are assisted by the inferior oblique, which limits the action of the rectus superior in looking downward and inward; the rectus inferior and the rectus externus by the superior oblique, which controls the full action of the rectus inferior. The movement downward and outward is accomplished by the rectus inferior together with the rectus externus and superior oblique, the latter limiting the action of the rectus inferior. From the central line the emmetropic eye may move inward 45 degrees; outward 50 degrees; upward 35 degrees; and

downward 60 degrees. These movements are restricted in myopic eyes by the increase in the antero-posterior axis. In binocular vision there is an associated movement of both eyes, the movement inward of one being accompanied by an outward movement of the other, the different sets of muscles acting in this way being termed *conjugate*, or *yoked* muscles. In the accommodative or converging movements of the eyes, similar groups of muscles act in harmony. A disturbance of the harmony of the action of the muscles at once causes a deviation from the line of vision, and may result from an excess or loss of power of one or more muscles. This is termed the *primary deviation*, and produces diplopia and squint. If one of the conjugate muscles becomes weakened or paralyzed, a greater effort becomes necessary to enable it to attempt the motion of the eye. This effect, being transmitted to its conjugate muscle, produces there another action and consequent greater movement. This change in the direction of the other eye constitutes the *secondary deviation*.

The muscular adjustments must be exact, and the motor influences transmitted just sufficient to produce that perfect harmony of action necessary to direct the yellow spot of the retina of each eye upon the object, and thus produce binocular vision. If the foveæ are not focused upon the object, or if the images of the object do not fall upon corresponding portions of the two retinæ, then double vision or diplopia occurs.

In the normal eye, when the gaze is fixed upon an object at a distance, the visual axes appear parallel. In myopic eyes the axes may converge slightly, owing to the foveæ lying nearer to the axis of the eyeball, an apparent turning inward of the eyes. In hypermetropia the axes of the eyes frequently diverge slightly; this is not, however, divergent strabismus, but is due to the fact that the yellow spot usually lies farther from the axis of the eyeball in hypermetropic than in emmetropic or myopic persons, hence, when the optic axis of the eye is directed towards distant objects, the axis of the eyeball looks outward more than in the normal eye, giving rise to the appearance of divergent squint.

DIPLOPIA.

Diplopia, or double vision, arises when the visual axes are not both directed upon the object under examination, and is almost always caused by a deviation of the eyes or *squint*, but this may appear so slight as to escape attention in many cases. Double vision is sometimes monocular, depending upon irregularities of the cornea, lens, or some disturbance of the retinal elements. It is, however, almost always binocular, disappearing when one eye is covered. Binocular diplopia is of two kinds, *homonymous* or *direct* and *hieronymous* or *crossed.*

Direct diplopia will be understood by an examination of Fig. 45, which shows the position of the double images in convergent squint. Here M represents the macula lutea, or yellow spot of each eye, O the object looked at, and V M the visual axis of the squinting eye. The image of the object O will fall upon the yellow spot M in the left eye, and the object is seen in its true position and forms a true image. The visual axis of the right eye deviates inward and the image falls upon a portion of the retina to the inner side of the yellow spot, and the object will appear to be at F I, because the part of the retina which now receives the image has been accustomed to receive objects from this direction when the eye was in its normal position, and hence mentally projects the image in that direction. Thus two images become visible, one in its real position at O and another to the right of it at F I, the latter being the

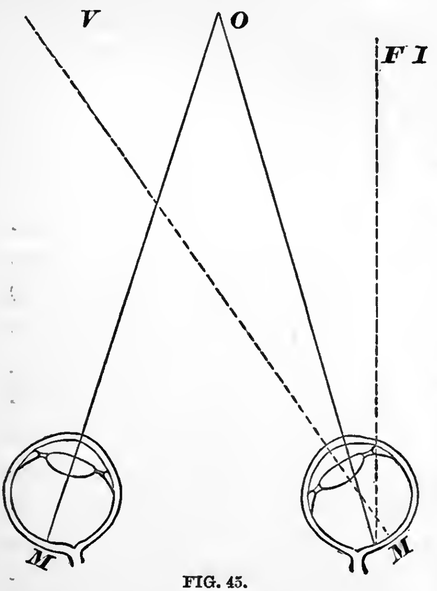


FIG. 45.

false image. If the left eye is turned in and the right eye remains in the normal position, then the false image will be to the left of the true image. In these cases the greater the deviation of the eye the greater the squint, and the wider apart are the two images. The false image, falling upon an eccentric portion of the retina, is not usually as distinct as the true image, which is formed upon the yellow spot; the greater the squint the less distinct will the false image be, as it is then formed still further from the central portion of the retina.

In the second form, or crossed diplopia, the images cross each other as shown in Fig. 46. Here, a divergent squint is present, the left eye being fixed upon the object at *O*, and the right eye deviating outward from its fellow. The object at *O* is perceived in its proper position by the left eye, and a true image is formed upon the macula lutea at *M*. The right eye, however, being turned outward, the macula is directed toward *V*, and the image of the object at *O* falls upon a portion of the retina to the outer side of the macula, and is mentally projected to the left of *O* at *F I*, and the false image is thus seen to the left of the true image, and they appear crossed. If the squinting eye is turned upward, the image falls upon the retina above the macula and appears below the true image. If the eye squints downward, then the false image is projected above the true image as seen by the other eye. The false image formed in cases of squint, if sufficiently well defined, will

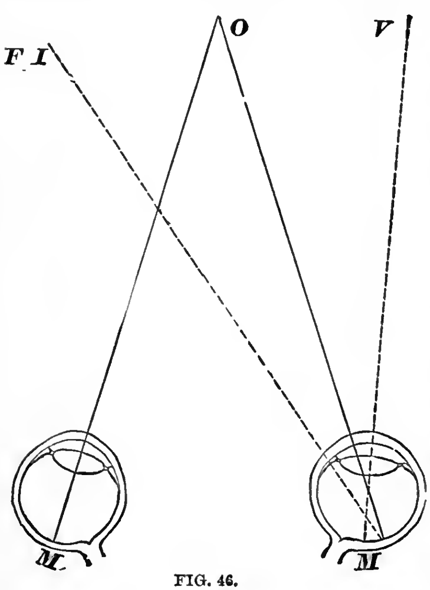


FIG. 46.

be perceived, and the images received by the two eyes, being superimposed in the sensorium, will cause a confusion of the vision, and vertigo, nausea or pain results. In many cases, particularly if the deviation which causes the diplopia is great, or exists for a long time, only one image is regarded, the perception of the other being neglected or suppressed; the suppressed image always being that of the squinting eye. To detect the presence and position of the double images in diplopia, the patient should be taken into a dark room, the head fixed or held in one position without moving, and a colored glass, blue or red, placed before one eye. A lighted candle is then held eight or ten feet distant and moved to the right, left, above, below, and other intermediate portions of the field, and the patient asked which is the colored flame. The position of the images, as described by the patient, are then noted upon a slip of paper, but if the deviation is very great, and, particularly, if the action of the internal rectus is poor, the false image becomes indistinct, and difficulty is experienced in getting proper replies from the patient; in such case it is better to place the colored glass before the sound eye. The greater the distance of the candle and the farther it is moved in the direction of the affected muscle, the more widely separated the images become. For all practical purposes a roll of white paper one foot long, held perpendicularly ten feet distant from the patient in a lighted room, will suffice; one eye should be covered with a red glass and the height, lateral separation and apparent distances recorded as before.

PARALYSIS OF THE OCULAR MUSCLES.

In rare cases all of the muscles may be paralyzed, the third, fourth and sixth nerves all participating. In the majority of cases single muscles, or those supplied by one nerve, are alone affected. In many cases the condition may be only one of paresis, which may follow or precede the paralysis. The affection is seldom symmetrical, and in rare cases where it

does occur, the cause is always intra-cranial or spinal. Where it is monolateral the lesion may be either local or central. In most of the cases of uncomplicated paralysis of the ocular muscles, there is nothing in the state, either of the eye or orbit, to enable one to locate the cause either in the orbit or cranium. The probable location of the lesion, in either case, may be determined by noting whether all the muscles supplied by the third nerve are affected or only one of them, or whether the fourth or sixth nerves are alone affected, while bearing in mind their origin and course in the brain and orbit.

Causes.—Rheumatism, syphilis, localized periostitis, inflammation of the nerve sheath, injuries, basilar meningitis, tumors of any kind, hemorrhage and central nerve degenerations, are all active causes in the production of paralysis of the ocular muscles.

Symptoms.—*Loss of mobility* in the direction of the paralyzed muscle is, objectively, the most prominent symptom. If the patient is directed to look at an object, as the finger, held before the eye, and follow its movements without changing the position of the head, the affected eye is found to fail in its movement in the direction of the affected muscle in proportion to its weakness. Subjectively, *diplopia* is complained of, and this is often present before the loss of motion can be detected. The position of the images, whether homonymous or crossed, and above or below, will give a clue to the muscles affected. With the diplopia there is often *false projection* of the field of vision, the image falling upon an eccentric portion of the retina, the patient is unable to determine the exact distance, and hence experiences difficulty in walking, or reaching for objects, and this not infrequently results in nausea and vertigo, or other cerebral symptoms. The head is usually inclined in the direction of the affected muscle so as to lessen the diplopia by favoring it, or the eye is closed to obviate double images. Undue prominence of the eye occurs in paralysis of all the recti, and is accompanied by a drooping of the lid (ptosis).

Squint is always a symptom of paralysis, where the affection has existed for some time, and is due to the contraction of the

opposing muscle, the eye being permanently fixed in the direction opposite to the paralyzed muscle; and when this occurs, the vision of the affected eye rapidly deteriorates from the suppression of the image, and amblyopia from non-use results. In paralytic squint, if the hand is placed over the sound eye in such a manner that its movements may be observed, while the affected eye is directed upon the object held before it and moved in the direction of the paralyzed muscle, the eye will attempt to follow it. The effort thus made is transmitted to the conjugate muscle of the other eye, and a motion of the sound eye will occur, which will carry it so far as to produce a squint which is greater than that of the affected eye; this is termed the *secondary deviation* or squint. In paralytic squint this secondary deviation is always greater than the primary deviation of the affected eye.

DIAGNOSIS OF PARALYTIC AFFECTIONS OF DIFFERENT MUSCLES.

Rectus Internus.—While the isolated paralysis of the branches of the motor oculi are not common, the branch supplying the internal rectus is more frequently affected than the others. The eye cannot be turned inward, and divergent squint may result. Diplopia appears, and the images are crossed vertically and on the same level, and become wider apart; or the false image disappears when the object is carried to the opposite side of the affected muscle. The patient turns the head toward the direction opposite to the paralyzed muscle to overcome the diplopia as far as possible.

Rectus Superior.—If the nerve supply of the superior rectus is deficient the patient finds difficulty in ascending stairs, as the false image is projected above the true image, diverges from it at the top and is slightly crossed, and a downward squint results. As the superior division of the third nerve also supplies the levator palpebræ, ptosis is almost always a complication. To correct the diplopia the head is directed upward and backward.

Rectus Inferior.—If the rectus inferior is paralyzed, the

eye cannot be turned downward, although there is an oscillating movement in that direction resulting from the action of the superior oblique. The diplopia is somewhat crossed, the false image is below, but converges at the top and appears closer to the eye than the true image. Difficulty is experienced in going down stairs or in walking, and to overcome the defect the head is carried forward and downward. If squint results the eye is turned upward.

INFERIOR OBLIQUE.—The eye cannot be rotated upward and outward, and when an attempt is made to look upward the superior rectus carries the eye upward and inward. It rarely, if ever, occurs without some of the other muscles being involved. The double images are crossed and appear one above the other and the false image is inclined towards the other at the bottom. If the eye is moved inward the difference in the height increases, and when turned outward, the inclination of the images becomes more marked.

PARALYSIS OF THE THIRD NERVE.—In complete paralysis of the third nerve, the uppei lid droops over the ball (ptosis) and the eye is turned outward and cannot move in any direction except partly downward. The pupil is dilated, the accommodation paralyzed and the eyeball is more prominent from the loss of the normal tension of the recti. When all the muscles supplied by the third nerve are affected, the lesion exists either at the apex of the orbit or in the cranium. If only one or two of these branches are paralyzed the cause is situated in the orbit.

SUPERIOR OBLIQUE.—Here there is homonymous diplopia in the lower half of the visual field. The eye lags when the vision is directed downward, the ball moving downward and inward. The double images separate more widely and the upper ends are inclined toward each other. The patient finds difficulty in descending stairs, and endeavors to correct it by carrying the head forward and to the opposite side of the eye affected.

EXTERNAL RECTUS.—The paralysis of the abducens is more frequent than the other forms, and causes, as it is complete or

partial, more or less inability to turn the eye beyond the middle line. The diplopia is homonymous and is more marked when the object is moved to the affected side, lessening and disappearing as the eye is turned inward. The images are parallel, perpendicular and on the same level, but when the object is moved diagonally upward and outward the false image is lower than the true, diverging slightly at the top, and when moved downward is higher, inclining slightly at the top, and appears nearer to the patient, while convergent squint generally results. The patient endeavors to overcome the faulty action of the muscle by turning the head in the opposite direction to the affected eye.

TREATMENT.

When the paralysis is effected by rheumatic or syphilitic causes the prognosis is usually very favorable, but when arising from intra-cranial or spinal disease, recovery is less likely to occur. If the recovery is not complete, paralytic squint and diplopia usually remain. The treatment must be addressed to the probable cause, and to discover this requires a very careful inquiry into the history, symptoms and condition of the patient. The ophthalmoscope may prove an aid by revealing the presence of an optic neuritis dependent upon intra-cranial or orbital specific lesion.

Faradaism and galvanism may prove beneficial and in some cases effect a cure alone. The galvanic current appears more useful than the faradic, and the application should last but a minute, and be made daily. A small bulb electrode, covered with wet chamois skin, may be applied to the conjunctiva directly over the insertion of the muscle, or in the same position upon the closed eyelid. The other pole may be applied to the occiput or to the mastoid. Usually, the negative electrode should be applied to the eye, but some cases will be more benefitted by the reverse current. The strength of the current must not be sufficient to cause vertigo, nor the electrodes suddenly lifted after having been applied to the head. A small

percentage of cases will be improved by the use of the faradic or galvanic current applied to the angle of the jaw and to the supra-orbital region and side of the nose; the result accomplished being due to the reflex irritation through the fifth nerve.

Prisms set in spectacle frames may correct the double vision, but practically prove of little service, as the prism can only relieve a certain amount of the diplopia, which varies with the direction of the vision. To determine the degree of the prism required, the patient is directed to regard a lighted candle or gas-jet, ten or twelve feet distant, when he will see two images of the light. The weakest prism, base in or out according to the muscle affected, which will unite the images will be the one required, but if it is over eight or ten degrees, then the prismatic glasses become too bungling for comfortable wear and the effect may be divided between the two eyes, and the affected eye given slightly more than one-half the whole degree. After a week or two it may be found that weaker prisms will enable him to fix the images, and the glasses should be accordingly changed until very weak prisms, or none, are required.

In addition to the aids already recommended, medical treatment will prove useful in many cases when the remedies are selected according to the cause and symptoms.

Aconite.—This remedy suits those cases of partial paralysis arising from exposure to cold winds or draughts.

Argentum nitricum.—Cases of paralysis of the internal rectus have been relieved by this remedy.

Arnica.—Commonly indicated in those cases of temporary paralysis resulting from injury.

Causticum.—Paralysis of the muscles resulting from exposure to cold, particularly of the external rectus, with some involvment of the third nerve, and may be useful in a general peripheral paralysis of any of the ocular muscles.

Chelidonium.—Paralysis of the right external rectus.

Cuprum aceticum.—Paresis or paralysis of the external rectus.

Euphrasia.—Paralysis of the branches of the third nerve arising from exposure to cold or wet, the other symptoms of Euphrasia being present.

Gelsemium.—Extremely valuable in those cases following diphtheria, the action upon the external rectus being more marked.

Kali iodatum.—Particularly indicated in paralysis of the muscles arising from syphilitic causes, more commonly the paralysis of the rectus externus.

Mercurius iod.—Paralysis of the third nerve and its branches in cases arising from syphilis.

Nux vomica.—Paralysis or paresis of the ocular muscles, accompanying gastric disturbances, and if aggravated by tobacco or stimulants.

Phosphorus.—Paralysis of the muscles arising from excesses, and accompanied by general loss of muscular tone.

Rhus tox.—Paralysis of the muscles arising from rheumatism, exposure to cold and wet.

Senega.—This remedy has been reported as curing loss of power of the left superior rectus and other branches of the occulo-motorius, and is beneficial in paralysis of the superior oblique.

Other remedies, as Aurum, Hyoscyamus, Conium, Morph. and Sulphur may be used with advantage.

Paralytic squint, arising as it does from the secondary contraction of the opposing muscle, requires operative measures for its relief when the recovery of the paralyzed muscle is hopeless. For its correction, tenotomy of the contracting muscle should be made.and at the same time the insertion of the paralyzed muscle advanced, as will be described for certain cases of strabismus.

MUSCULAR ASTHENOPIA.

Paresis of the muscles, muscular weakness or insufficiency, is not usually great enough to produce any deviation of the eyes or squint, but manifests itself in pain or fatigue

after use of the muscles involved. The muscles most commonly affected are the internal and external recti. In rare cases the insufficiency may be traced to the superior oblique, and to the superior and inferior recti.

Causes.—Refractive errors are usually the productive causes of muscular asthenopia; myopia and astigmatism producing weakness of the internal rectus, and hypermetropia of the external rectus. The other causes productive of muscular asthenopia in either emmetropia or ametropia, are, fatigue of the eyes from over-work on fine objects, as in flower or china painting, embroidery, etc.; general neurasthenia, when the muscular insufficiency may accompany or follow the general condition; convalescence after continued fevers or the exanthemata, particularly reading in a prone position; uterine diseases; chorea; excesses of any kind; derangement of the digestive organs; insufficient food; or, the muscular weakness may be congenital.

Results in
1-Paresis.
2-Spasm.
3-Strabismus.

Symptoms.—The symptoms are those of fatigue from use of the eye. There is pain which may be referred to the eyeball, forehead, temple, or vertex, producing what may well be termed *asthenopic headaches.* The pain is temporarily relieved by pressure upon the closed eyes and momentary rest. Dizziness and nausea are not infrequent accompaniments of the condition. After reading for a time the letters may appear to dance or swim before the eyes, producing a blur, which is similar to that occurring in weakness of the accommodation. > rest.

Insufficiency of the internal recti is more common than the other forms, and is produced by the lighter degrees of myopia, the strain upon the internal recti being relieved by the divergence of the eyes in the higher degrees. It appears, however, with almost equal frequency in emmetropic, rarely in hypermetropic eyes, from the causes already enumerated.

Insufficiency of the external recti occurs with much less frequency, and hypermetropia forms the most common cause. The ciliary muscle not infrequently participates in the weakness, when the case becomes complicated with accommodative asthenopia or ciliary spasm.

Symptoms.
1- Tired feeling. 2 Pain indefinable, where a -3 Diplopia - 4. Blurring.
5- Burning & smarting. 6- Lachrymation - 7 Dizziness & nausea.
8- Think going blind - 9 > rest (always better in morn)

Diagnosis.—The diagnosis is readily made by directing the patient to look at the finger or pencil, held eight or ten inches from the eye in the median line. One eye is then covered by a card in such a manner as to shut out the eye from the object of fixation, but at the same time to enable the observer to see if it deviates outward. A more delicate test is that of Von Graefe where a prism of eight or ten degrees is placed with the base up or down before the eye, and the patient directed to look at a black dot on a vertical line, as in Fig. 47, held at the usual reading distance. If the relative strength of the muscles is normal, two dots will be seen on the same line, but if two lines appear with a dot upon each, the lateral separation of the lines measures the insufficiency, or it may be measured more accurately by the prism, with the base turned inward or outward, which is sufficient to fuse the images of the two lines; placing a colored glass before one eye will determine whether the images thus formed are homonymous, as in affections of the internal recti, or crossed, as with insufficiency of the external recti.

FIG. 47.

Treatment.—The treatment consists principally in the correction of the refractive error, the methodical exercise of the eyes for increasing periods daily, and the use of such remedies as have an action upon the ocular muscles. This is usually all that is needed to complete the cure; where myopia is the cause, the glasses may be slightly decentred, or prisms with the base inward combined, or weaker glasses than those required for distant vision prescribed. If hypermetropia is the active cause, the glasses to correct the refraction may be required to be worn constantly, or combined with prisms, or decentred, or set nearer together. Slight degrees of astigmatism which are not sufficient to impair the visual acuity may be required to be corrected by glasses which are to be worn constantly. The galvanic or faradic current, often improves the muscular tone and may be applied for two or three minutes daily, one pole over the closed eyelids and the other

upon the temple or nape of the neck. Treatment which tends to improve the general vigor of the patient and remove any constitutional derangement, improve digestion, and increase the general muscular tone, is indicated.

For the *methodical exercise* of the eyes, the patient is to read in the morning, after breakfast, for two, three or five minutes the first day, and the length of the reading period increased by one or two minutes a day until half an hour, or an hour is reached; no additional increase is now made for several days, then another sitting may be begun for increasing periods. The sittings should always stop short of fatigue, and it may be necessary to return to a less number of minutes until the first point of fatigue is again passed comfortably.

The *gymnastic exercise* of the muscles by the use of prisms of varying degrees, the bases of which are turned alternately in or out, may be useful in a few cases, but the results are not as favorable as they would seem likely to be. The patient takes the prisms of five, ten, or fifteen degrees, placing the bases in or out according as the weakness is of the internal or external recti muscles, and tries to fuse the images of a gas-jet fifteen or twenty feet distant. Still stronger prisms are used the next day, and the exercise continued until a satisfactory increase in the power of the muscle has taken place. I have known patients by daily exercise to finally overcome prisms amounting to sixty degrees in adduction without improvement in the symptoms of asthenopia, although there was a constantly increasing improvement in the adductive power of the internal recti. Much relief is experienced in asthenopia by the prescription of the proper medicinal remedy according to the following indications:

Aconite.—Asthenopia from over-use of the eyes; lids spasmodically closed with a heavy feeling in them. Hot and dry feeling of the eyes after use, relief from cold applications.

Agaricus.—Twitching of the lids, jerking or sensation of jerking in the eyeballs.

Argentum nitricum. — Weakness of the internal recti, together with weakness of the accommodation dependent upon hyperopia; blurring and dancing of the letters.

Duboisia.—External recti weak, with weakness of the accommodation, and hot dry feeling of eyes from reading.

Calcarea carb.—Pains after using the eyes; pains referred usually to the lids; sticking pains while using the eyes for close work; eyes feel better from applications of hot water.

Gelsemium.—Asthenopia with weakness of the external recti, often associated with spasmodic condition of the internal recti.

Jaborandi.— Asthenopia, with symptoms which are really dependent upon irritability of the ciliary muscle, and in those cases of muscular asthenopia arising from reflex irritation of the uterus.

Kalmia lat.—The muscles, either the internal or external recti feel stiff, eyeballs feel stiff.

Lilium tigrinum.—Burning, smarting, and heat in the eyes; relief in the open air.

Mercurialis peren.—Dryness of the eyes and heaviness of the lids; mist before the eyes; burning pain in the eyes and upon reading.

Natrum muriaticum.—More frequently indicated than other remedies. Refractive error may or may not be present. Particularly suits those cases caused by over-use, or too close application for near objects; the vision blurs and the letters run together upon using the eyes for reading. Weakness of the internal recti is oftentimes very marked; the muscles feel stiff and drawn, and ache on using the eyes in any direction; pain in the eyes on looking down; suits some cases of asthenopia, with headache, burning, smarting, itching and heat with a variety of other sensations.

Phosphorus.—Deficiency of sight, with pain and stiffness in the eyeball; light aggravates so the patient is better in the twilight; symptoms of retinal irritation accompany.

Physostigma. —Weakness of internal recti. Fatigue and twitching of the lids from reading.

Rhododendron.—Insufficiency of the internal recti muscles with darting pains through the eyes and head, usually worse before a storm.

Sepia.—Some cases of muscular insufficiency arising from

reflex irritation of the uterus; smarting of the eyes; aggravation of the symptoms in the morning and evening.

Spigelia.—If accompanied by sharp sticking pains in the eye and around it, extending back into the head.

In addition to these many other remedies may be indicated by their constitutional symptoms, as Crocus, Cimicif., Ignatia, Ledum, Lith. carb, Macrotin, Nux vomica, Phos. acid, Pulsatilla, Santonine and Sulphur.

STRABISMUS.

Strabismus, or squint arising from paralysis of the ocular muscles has already been considered, but there is another form of squint which is dependent upon the contraction of certain of the ocular muscles, and is termed *concomitant strabismus*, or simple squint. In the paralytic variety there is loss of mobility of the eye in some directions, but with concomitant squint, the eyes when tested separately, are freely movable in any direction, although there is an inability to fix both eyes upon an object at the same time.

Of strabismus we have four varieties, convergent or internal, divergent or external, sursumvergent or upward, and deorsumvergent or downward.

CONVERGENT STRABISMUS.

The most common and readily treated is *convergent strabismus*, which depends upon a shortening of the internal recti muscles and generally commences in infancy. The visual axes cross in front of the object, and there is diplopia in the beginning, but the child soon learns to suppress one image, and from this suppression of the image the squinting eye soon becomes amblyopic from want of use. In most cases only one eye is used for vision and the other is turned inward towards the nose. In some cases one eye is used for a time and then the other; this constitutes *alternate squint* and in this case the vision is usually retained in both eyes. If the squint is not constant, but appears only at times, it is termed *periodic*

squint, but, after an interval of weeks or months, it becomes *permanent*. The amount of squint is generally greatest during near vision, and often disappears entirely when distant objects are looked at.

CAUSES.—The causes are variously stated by the laity as arising from convulsions, whooping cough, measles, scarlatina, fright, falls, and imitation of other squinting children. Some of these causes are undoubtedly the excitants in some cases, by producing a weakened condition, or paralysis of the external recti, which results in a preponderance of power of the internal recti. The common cause of convergent strabismus is, however, due to hypermetropia. When we look at near objects we do two things, we converge the optic axes by using the internal recti, and then accommodate for a near point, convergence and accommodation being physiologically connected. In hypermetropia accommodation is necessary for distant objects, and convergence, or a tendency to convergence, results. If binocular vision exists, the hypermetrope endeavors to form a single image, and consequently gives up the attempt to see at a distance, which would require the full exercise of the accommodation, and result in a convergence of the axes and in the production of diplopia. If the vision is more defective in one eye, the image produced upon the retina being less distinct than the other is disregarded, and convergence in accord with the full amount of accommodation is allowed, and, while the better eye is directed upon the object, the other is strongly turned inward. In these cases the internal recti become, from constant exercise, more highly developed than the external, and, having once overcome the latter, permanent contraction results. Convergent strabismus appears during the first years following infancy, the majority of cases occurring between two and five years of age, at the time when the child is just beginning to use the eyes for observation of its toys, picture books, or make its first attempts at reading. It may be only occasionally observed; later, it becomes alternating, and finally permanent.

The vision of the excluded or squinting eye rapidly

deteriorates from two causes; that most commonly given is amblyopia, or poor vision, from want of proper exercise of the region of the yellow spot at a time when the eye is still developing; secondly, compression of the eyeball by the tension of the rectus externus, which is put upon the stretch by the contraction of the internus. The necessity for early treatment in these cases arises, not for relief of the deformity, but to preserve the eyesight.

Diagnosis.—The diagnosis as a usual thing is easily made, the squinting eye not being directed towards an object held before the patient; but in some cases the deviation is not very great, and there may be some doubt as to which is the affected eye. In such cases the patient should be directed to look at the top of the finger of the surgeon, while each eye is alternately shaded with a card or the hand. The squinting eye moves when the other is covered, since the patient now directs it to the object; the other eye does not move when the squinting eye is covered.

The differentiation between a concomitant squint, and a paretic or paralytic squint arising from affections of the external rectus, is determined by the primary and secondary deviations, or squint, being equal in the former, while in the latter, if the sound eye is being watched behind the card while the patient regards the near object, the motion of the sound eye inward is much greater, and in addition there will be a loss of movement of the eye in the direction outward.

The degree of squint is measured by noting the distance between a vertical line drawn through the centre of the pupil and the lachrymal punctum of the lower lid. An ivory scale or strabismometer (Fig. 48) graded in lines or half lines or millimetres may also be used. This is placed against the lower lid of the squinting eye and the point of the vertical meridian of the cornea is noted; the other eye is now covered and the deviation noted in the same way, and the difference between the measurements thus made gives the amount of squint in lines or millimetres. The vision of each eye should be tested, and together with the amount of refractive error recorded, as

well as the amount of squint, and the relative strength of the external recti muscles will have a bearing upon the operative treatment in some cases.

TREATMENT.—While convergent strabismus shows a tendency to lessen as age advances, yet the importance of early operative treatment cannot be too strongly insisted upon, as the sight is often sacrificed from the delay occasioned by the expectation of improvement with age.

If the case applies for treatment before the squint becomes fixed, the use of atropine to paralyze the accommodation of the sound eye, or both eyes, by preventing near vision, lessens the tendency to convergence. If the eye has become permanently fixed and an early operation is not desired, the use of a bandage over the sound eye for stated periods daily will retain and increase the visual power of the affected eye; still better is the use of atropine in the sound eye, which will compel the squinting eye to again participate in the act of vision. The greatest objection to the use of atropine is the photophobia which arises from the dilatation of the pupil. These measures may prevent temporarily the increase of the squint and the advancing amblyopia, but the most effective results will be obtained by the use of proper convex glasses as determined by the ophthalmoscope, when the use of them is deemed practical in young children.

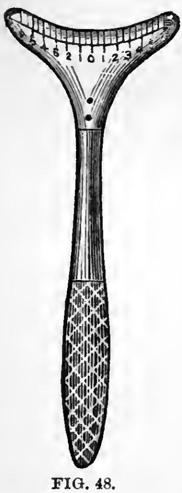


FIG. 48.

In many cases of squint the use of certain homœopathic remedies in the early stages has relieved the tendency to permanent strabismus. The most useful remedies are Belladonna, Aconite, Gelsemium, Hyoscyamus and Jaborandi. The remote causes, however, more frequently determine the remedy; as squint arising during dentition may demand Chamomilla, Belladonna, or Hyoscyamus; while if dependent upon some irritation of the digestive tract, Santonine, Cyclamen, Mercurius, Spigelia or Sulphur may be beneficial.

Convulsions or whooping cough may indicate Belladonna,

Hyoscyamus, Cuprum, Agaricus, Stramonium and Phosphorus. Some cases following measles and scarlatina I have relieved by the use of Belladonna, Cyclamen, and Phos. Acid; but care must be taken to improve the nutrition, as such cases do not present the squint except when the stomach is empty, or during the early stages of a meal. Benefit is often derived by increasing the number of meals during the day temporarily, or prescribing a table-spoonful of some native wine just before meals.

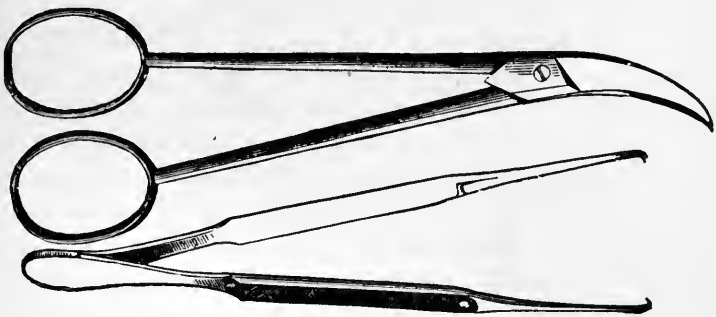
If the methods already stated do not improve the condition then tenotomy of the internal rectus becomes necessary, and its early performance should be insisted upon. In uncomplicated cases, the prognosis is very favorable. The operation consists in the division of the internal rectus at its tendinous insertion into the sclerotic, and its subsequent re-attachment farther back to allow the eye to resume its normal position. The time for the performance of the tenotomy will depend upon the permanency of the squint and the condition of the vision of the squinting eye. If the vision is poor the child may be operated upon at two years of age, but usually better results are obtained after six years of age, the effort having been made to maintain vision in the poor eye by methodical exercise. If the squint is periodic, or alternating, there is no danger of the sight diminishing unless the squint becomes permanent, and the operation may be delayed until then. Binocular vision is more frequently obtained where the operation is made early in life, but probably not over one third of the cases operated upon regain binocular vision, although parallelism of the eyes results. The amount of convergence must be the guide as to whether one or both internal recti require division, the fact that only one eye squints having nothing to do with making the decision. Both eyes are to be operated upon whenever the degree of squint amounts to over three lines, or 6 mm. If it is desirable, the operation may be made to correct one half of the squint, and after two or three weeks a slighter operation may be made upon the squinting eye. Equally good results are obtained when both

eyes are operated upon at the same time. In all cases where the squint is less than three lines, the tenotomy should be made upon the squinting eye alone.

After the eyes are again parallel as a result of the operation the use of glasses to correct the refraction may be necessary in order to prevent a return of the squint and maintain binocular vision.

OPERATION FOR CONVERGENT SQUINT.

For the operation a speculum, a pair of strabismus or fixation forceps (Fig. 49), a pair of curved scissors (Fig. 50) and



FIGS. 49 & 50.

two strabismus hooks (Fig. 51) are necessary. The patient is to be etherized in a recumbent position, and the operator stands behind the head, or at the side, as desired. Adults usually undergo the operation without the use of anæsthetics, but for children ether or chloroform should be used in accordance with the judgment of the operator. The speculum is introduced and holds the lids apart. If the eyeball rolls

FIG. 51.

upward under the influence of the anæsthetic, the conjunctiva below the cornea is caught by the forceps and the eye rotated downward into position; the conjunctiva and subconjunctival tissues over the insertion of the internal rectus muscle are now seized by the strabismus forceps and cut through with the

scissors, a small opening being made either vertically or horizontally, and the strabismus hook introduced into the opening and passed beneath the tendon, which is then raised upon the hook and carefully divided by several snips with the scissors close to the sclerotic, as in Fig. 52. The hook is again intro-

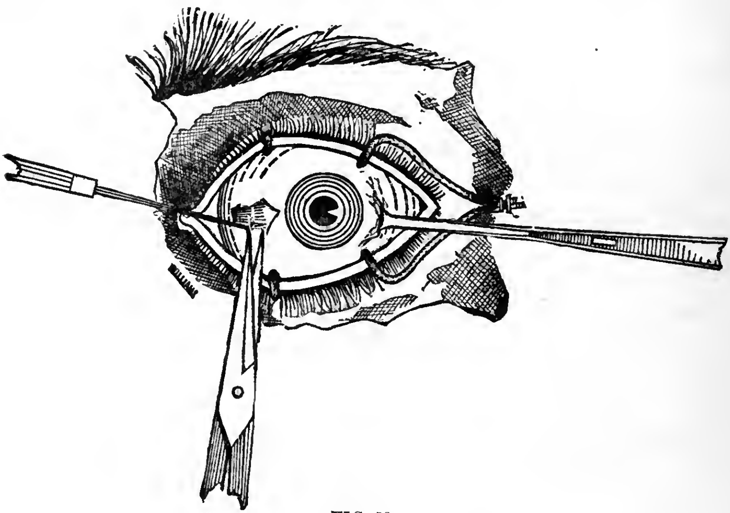


FIG. 52.

duced to ascertain whether all of the fibres of the tendon have been divided, care being taken not to produce much separation of Tenon's capsule by sweeping the hook too far round. There is usually a great deal of blood effused into the subconjunctival tissue following the division of the tendon. The more extensive the division of Tenon's capsule, the greater will be the effect of the operation, and much judgment and experience is necessary to decide how much will be required in any given case. The effect of the operation can be lessened by the introduction of a suture. To do this a curved eye-needle after being threaded with fine black silk is placed in the needle-holder (Fig. 53), and the conjunctiva at the margin of the cornea held by a pair of forceps while the needle is passed through, and then through the conjunctiva over the muscle, and the conjunctival wound brought together. This should be done before the patient recovers, and if not needed,

is easily removed afterwards. The patient is roused from the anæsthetic and made to look at the finger, held a foot distant before the eye, and the position of the eyes noted. If the amount of the operation has been well gauged the eyes will fix properly upon the object. The eye should then be directed towards the divided muscle, and if squinting results, or the eye moves inward, some fibres of the tendon have escaped cutting and the hook must be introduced and the fibres caught up and divided. As soon as the effect of the anæsthetic has passed off, the eyes are tested, and when the vision is good and the action of the muscles correct, the patient should be able to fix the eyes upon an object held eight or ten inches before him. If the eye, after a few moments, diverges, then the operation has been excessive and a suture should be introduced to lessen the effect. If the vision is poor, or the muscles weak, a convergence at twelve inches is sufficient. After the operation the eye should be bathed with cold water or a decoction of calendula flowers, no bandage being worn except from the clinic or office to the patient's home.

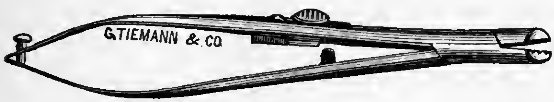


FIG. 53.

Diplopia is complained of in some cases on the second day, but usually disappears as the muscle regains power, and is not an unfavorable symptom. In some cases there is often a slight divergence for a few days or a week. The improvement in the vision of the squinting eye is, oftentimes, almost immediate, the loss of function here being dependent upon the tension of the recti muscles.

If the external rectus is weak, and the patient consents to have only one eye operated upon, a strong suture may be introduced through a large fold of the conjunctiva, which is picked up by the forceps between the outer margin of the cornea and the external canthus, the two ends of the sutures armed with needles being carried through the skin of the external canthus, one above and one below, so that they are separated one-eighth of an inch, and then tied. The eye is

thus held in proper position until the tendon becomes re-attached, which results after forty-eight hours, when the suture is removed. Severe reaction sometimes follows the introduction of these counter-sutures, which can readily be controlled by the use of cold compresses. Other operations for tenotomy are used by various surgeons according to individual ideas; when a slight correction only is necessary it may be done by making a short horizontal incision in the conjunctiva and subconjunctival tissue at the lower border of the insertion of the tendon, passing in the hook and dividing the tendon as before; the hemorrhage is very slight and there is less tendency to sinking of the caruncle. The eyeball becomes slightly more prominent after tenotomy and there is a corresponding sinking of the caruncle. In some cases a mass of granulations are developed about the stump of the tendon, which becomes pedunculated as the conjunctiva heals around it, and, either drops off spontaneously, or may be clipped with the scissors. If the operation has been excessive, a divergent squint will result, and require the advancement of the insertion of the opposite muscle.

DIVERGENT STRABISMUS.

This condition is much less frequent than the one already described, and is produced by the increased strength of the external recti over the internal.

Causes.—In myopia, which causes the larger number of cases of divergent squint, the accommodation is exercised when they converge, although the accommodation is an impediment to vision. If the patient is myopic, say $\frac{1}{18}$, with either eye he sees distinctly objects eighteen inches distant, but if both eyes are used he converges and hence accommodates. The object is now only seen at a distance of eight or ten inches from the eyes. This gives rise to pain and fatigue, and binocular vision is apt to be sacrificed for comfort, especially if the refraction of both eyes differs so that the image of one eye is less distinct than the other. The more defective eye is then

allowed to be drawn outward by the external rectus, which opposes the fatigued internal rectus, and divergent squint results. In bad cases there is not infrequently some shortening of the superior oblique muscle also. This squint may be periodic, alternating, or permanent.

If the eye is emmetropic, then the squint results from a paresis or insufficiency of the internal recti. If one eye is emmetropic and the other myopic no convergence is needed, as the former is used for distance and the latter for near vision. Opacities of the cornea and vitreous, and diseases affecting the choroid and retina, are other predisposing causes, the vision being so poor that convergence is not needed, and the external rectus turns the eye passively outward.

Diagnosis.—Divergent strabismus is distinguished from paresis and paralysis of the internus, by the primary and secondary deviations being equal in concomitant divergent squint. Thus when the affected eye suffers from paralytic squint, if the healthy eye is covered by the hand and the patient directed to look at an object which is moved in the direction of the paralyzed muscle, an effort will be made to do it, this effort will be transmitted to the conjugate muscles of the other eye, and the healthy eye will squint more than the paralyzed eye. While if the squinting is concomitant, the primary deviation of the affected eye will be equal to the secondary deviation of the well eye.

Treatment.—When dependent upon refractive error proper glasses are to be provided and worn as detailed in Myopia. If the case is not soon relieved the full correction of the myopia should be made, unless the condition of the eye is such as to forbid it. Usually the condition is permanent before application for relief is made, and tenotomy of the internal rectus is necessary. The operation is made in the same manner as that described for the internus. The change in position of the eyeball, and the insertion of the tendon at a greater distance from the cornea are to be borne in mind. If the internal rectus is in good condition, the division of the external rectus will lessen the deformity 3 to 4 mm. If the correction by a

single tenotomy is not sufficient, both externi may be divided, the danger of over-correction not being very great. In bad cases a better result is obtained by the advancement of the internal rectus.

SURSUMVERGENT STRABISMUS is due to the abnormal development of the superior rectus, and the patient squints upward. It is readily diagnosed from paralysis of the inferior rectus. It is very rare, and in two cases which I have observed the squint was congenital. One was relieved by tenotomy of the superior rectus.

DEORSUMVERGENT STRABISMUS is due to a contraction of the inferior rectus, and the patient squints downward. It is still more rare than the opposite condition and may be relieved by a tenotomy.

THE ADVANCEMENT OF THE MUSCLE.

This becomes necessary if a muscle is excessively weak, paralyzed, or the tendon, after an operation, has become attached too far back; the design being to increase the power of the muscle by shortening it. There are several ways of making this operation, which consists simply in dividing the tendon at its insertion, and, by means of sutures, bringing it forward so that it may become reattached nearer to the cornea. Not more than 4 mm. can be corrected in this way. If the divergence requires it, a second correction may be made.

For the operation the patient should be etherized, the lids separated by a speculum, and the tendon of the opposing muscle divided and allowed to drop back. The tendon of the squinting muscle is then taken up on the hook, and before division two fine black silk sutures with a needle at each end, are passed from the under side of the tendon as far back as is necessary, one through its upper portion and the other through the lower: the needles of the inner portions of the sutures are then passed through the conjunctiva above and below the corneal margin, care being taken not to change the position of the vertical meridian; the tendon is then cut and the ends of the sutures brought together and tied. The ends of the ten-

don overlap, and it may be necessary to cut away a portion of the tissue in front of the tendon; the sutures are left in position four or five days until union takes place. The eye is bandaged and undue reaction prevented by cold applications, and Aconite or Calendula. When the internal rectus is to be advanced without division of the external, the result of the operation is made surer by the use of a suture passed through the conjunctiva below the cornea, between the cornea and outer canthus, and then brought inwards and passed through the cuticle of the bridge of the nose and tied. The use of De Wecker's double clamp strabismus hook materially aids the operation by holding the tendon firmly and preventing its slipping back, an accident which is liable to occur.

NYSTAGMUS.

Nystagmus is usually a congenital affection of the ocular muscles, characterized by a pecular oscillatory movement of the eyeball, which becomes more rapid during efforts to see near objects or under excitement. It manifests itself in infancy and is generally associated with anomalies of refraction, together with opacities of the cornea or lens, and lesions of the choroid, retina, or optic nerve. In some cases, with the absence of objective lesions, a cure has followed the use of either Hyoscyamus, Belladonna or Stramonium. In other cases, in older children, the use of glasses, particularly for the correction of hypermetropia and astigmatism, has given good results. In the acquired form it is frequently presented by coal miners, the condition arising from the narrowness of the drift in which they are working, which requires the prolonged use of the eyes in an upward direction. The condition frequently disappears with return to the outside world and from prolonged rest.

CHAPTER VII.

DISEASES OF THE ORBIT.

ANATOMY.

The bony cavities which contain the eyeball and its accessories are pyramidal fossæ, irregularly quadrilateral, with their bases directed forward and slightly outward, their inner walls being nearly parallel, while the outer walls diverge so as to be nearly at right angles to each other. The roof of the orbit is formed by the orbital process of the frontal and small wing of the sphenoid, and is somewhat concave and smooth. Anteriorly it divides into two plates which inclose the frontal sinus, while posteriorly it separates the orbit from the cranial cavity and the overlying anterior lobes of the brain. At its anterior margin is the supra-orbital foramen or notch, while at the external angular process is the depression for the lachrymal gland. The floor is formed anteriorly by the orbital processes of the malar and superior maxillary bones, and at the posterior part by the small orbital plate of the palate bone. It is grooved for the infra-orbital nerve, and below it lies the antrum of Highmore. The inner, or nasal wall, is smoother and thinner than the others, and is formed by the processes of the superior maxillary, the lachrymal, ethmoid, and sphenoid. In the anterior portion is the lachrymal groove for the reception of the lachrymal sac, formed by the superior maxillary and lachrymal bones, and leading into the nasal duct. In its posterior portion, between the ethmoid and

frontal bones, are two foraminæ, the more anterior giving passage to the nasal branch of the ophthalmic nerve into the cranium, and the posterior to an artery into the nose. The outer wall inclines outward, is nearly flat and made up of the orbital surfaces of the malar bone and the great wing of the sphenoid, and is strengthened by the zygomatic process. The sphenoidal, or superior orbital fissure, at its inner extremity occupies the apex of the orbit, while its outer and narrower part lies between the roof and the external wall. Through this fissure, pass the ophthalmic veins, the third, fourth, and branches of the ophthalmic division of the fifth, and the sixth nerves. The foramen opticum, for the passage of the optic nerve and the ophthalmic artery, is internal and superior to the sphenoidal fissure. It is a short canal, 8 mm. long and 6 mm. wide, lined by the dura mater. In the angle between the outer wall and the floor is the spheno-maxillary or inferior orbital fissure, which transmits the superior maxillary nerve,

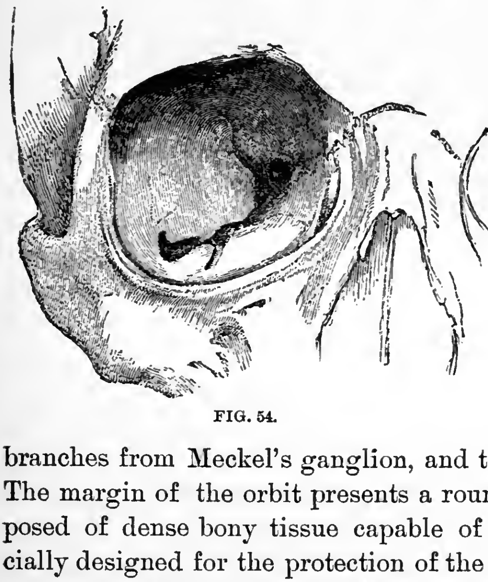


FIG. 54.

branches from Meckel's ganglion, and the infra-orbital artery. The margin of the orbit presents a rounded edge, and is composed of dense bony tissue capable of great resistance, specially designed for the protection of the soft tissues inclosed in the orbit. The bony walls of the orbit are covered with periosteum, which is loosely attached, except at the optic foramen and the orbital margin. The dura mater at the edge of the optic foramen forms a thick tendinous ring from which the recti muscles, superior oblique and levator palpebræ arise. As it leaves the foramen opticum it divides into two parts, the one forming the periosteum of the orbit which is continuous

with that of the frontal and facial bones. At the margin of the orbit a portion is reflected to cover the tarsal ligaments forming the tarso-orbital fascia for the retention of the contents of the orbit. The other portion of the dura mater forms a sheath, for the optic nerve and the posterior three-fourths of the eyeball, termed the capsule of Tenon. This fascia separates the eyeball from the muscles and fat, and enables it to roll freely in all its movements, and is lined with endothelial cells. At the sclero-corneal margin a part of the fascia is lost in the sclera, the balance passing behind the conjunctiva to the tarsal ligament where it is continuous with the layer forming the periosteum, thus forming a closed sac containing the tissues of the orbit, but excluding the eyeball and optic nerve; within this fascia is a continuation of the arachnoidal membrane from the brain, and the space between the two is continuous with the arachnoidal space of the brain. From the tarso-orbital fascia delicate prolongations of connective tissue pass into the orbit to support the fat cells, blood-vessels, nerves and muscles. The arteries of the orbit are derived from the ophthalmic which arises from the internal carotid and lies in the optic foramen to the outer side of the canal. The veins of the orbit empty into the cavernous sinus, which is separated from the orbit by the tissue of the sinus itself.

DISEASES OF THE ORBIT.

The diseases of the orbit most commonly met with are inflammation of the cellular tissue filling the cavity, capsulitis or inflammation of Tenon's capsule, periostitis, with caries and necrosis, and diseases of the blood-vessels, and tumors. All these affections produce an increase of the contents of the orbit from inflammatory infiltration, and the tarso-orbital fascia being resistant, the result is the displacement of the eyeballs forward, or *exophthalmus.* Protrusion of the eyeball, however, is not always due to orbital lesions, but may result from inflammation of the eyeball itself (*panophthalmitis*); injuries resulting in the dislocation of the globe; paralysis of the recti

muscles; tumors within the eye; myopia; and staphyloma of the sclera. Again, we may find the protrusion due to affections of the dura mater, as in hydrocephalus; tumors of the brain; diseases of the lachrymal gland; and diseases and growths of the frontal sinus, antrum and nasal cavities. The direction of the displacement of the eyeball and its condition as regards size, shape and mobility will enable us to diagnose the affection which is productive of the protrusion.

ORBITAL CELLULITIS.

Inflammation and suppuration of the cellular tissue of the orbit is an affection of much gravity, as it is usually fatal to vision and not infrequently productive of death.

Causes.—The causes are more frequently those from injury of the orbit, as laceration of the eyeball, contusion, or puncture of the tissue of the orbit by foreign bodies, or operations upon the eye, as after tenotomy of the muscles. It more rarely appears as a complication of periostitis, extension of erysipelas, or as a metastatic abscess in pyæmia, or puerperal fever, and incidental to small-pox and meningitis.

Symptoms and Diagnosis.—The disease commences with severe pain, usually of a throbbing character, in and around the eye, extending to the temporal side of the head and muscles of the neck, accompanied with swelling and redness of the eyelids; fever sets in and the patient is restless, with mild delirium or disturbed dreams; the conjunctiva becomes chemosed or swollen, but there is no increased discharge; the eyeball appears immovable and is rapidly protruded by the inflammatory effusion into the contents of the orbit. The resulting tissue changes are exudation from the overcharged blood-vessels and cell prolification; this results in a matting together of the muscles and other tissues of the orbit. The inflammatory process may extend to the sheath of the optic nerve, and a neuritis result, or the pressure of the contents of the orbit interfere with the circulation in the nerve, inducing atrophy of the disc. The chemosis of the conjunctiva may be sufficient

to cause sloughing of the cornea, or the whole eyeball may participate in the inflammatory action. The formation of pus is characterized by rigors, and is diffused through the orbit, or gradually makes its way towards the surface, to discharge through the conjunctiva, or skin. Inflammation of all the tissues of the eye, or panophthalmitis, may complicate the attack, or the inflammatory process may extend backward, and the membranes of the brain become involved, with the production of cerebral symptoms.

Differential Diagnosis.—The disease will be most likely to be mistaken for the first stage of purulent conjunctivitis, but the absence of any discharge from the chemosed conjunctiva will determine the diagnosis. It differs from panophthalmitis in the more or less fair condition of the vision; from periostitis, by the absence of diplopia and the equal displacement of the eyeball; from tumors and malignant growths of the orbit, by the presence of acute inflammatory symptoms and pain.

Duration and Prognosis.—The disease is usually very acute and passes through all its stages in a few weeks, but certain cases may become chronic and last for months. In the acute form fluctuation may be determined by the eighth or twelfth day at one or more points at the upper and inner part of the orbit. The pus does not readily point, owing to the dense tarso-orbital fascia, but as soon as the pus has been diagnosed and evacuated spontaneously, or by the knife, the pain and swelling diminish, the eyeball recedes and the parts soon return to their normal condition. The eyeball may be destroyed by the extension of the inflammation, or pus forming in the interior will require an incision through the anterior portion of the eyeball for its discharge, and destruction of the vision with atrophy of the eyeball will result. The pressure of the contents of the orbit, or the extension of the inflammation to its sheath will cause atrophy of the optic nerve. Loss of motion of the eye, or atrophy of the eyeball, may result from extensive destruction of the orbital tissue or necrosis of the bones of the orbit. The chronic variety is characterized by more moderate

swelling, pain and protrusion, and is more frequently a complication arising from periostitis in strumous and syphilitic patients.

Treatment.—The treatment consists in the constant application of ice bags, or cold compresses in the early stages; later, when suppuration is inevitable, the use of hot compresses, and poultices, are indicated. As soon as pus is formed, the abscess should be opened at the earliest possible moment. If fluctuation is discernible, a free incision should be made with a long double-edged cataract knife close to the wall of the orbit, and a drainage tube inserted. If the diagnosis of pus is not positive and the pain is great, an incision with a linear cataract knife should be made along the upper or lower wall, as the indications may present, and if pus follows the knife, a tent or drainage tube should be inserted.

Aconite.—When the inflammatory symptoms first appear. The lids are swollen and tense, the conjunctiva chemotic, and much heat and general sensitiveness of the eye and surrounding parts, with general febrile excitement are present.

Bell.—Oftentimes follows the use of Aconite in the first stages and presents the same indications as regards the eyes, except that the hyperæmic condition of the lids is usually of a darker hue, and general cerebral congestion is present.

Apis mel.—In the first stage when there is much œdema of the lids and conjunctiva, with stinging, shooting pains in and around the eye. Drowsy, thirstless condition.

Rhus tox.—One of the most valuable remedies for the first stage of cellulitis whether arising from injury after operation, or from other causes. The lids and conjunctiva are œdematously swollen, but usually harder to the touch than under Apis. The pains may be of any description. The general restlessness is very marked.

Phytolacca.—Stands next to Rhus in value for cellulitis but suits sub-acute and chronic cases better. The pain and inflammatory symptoms are all more moderate. The lids are hard, as is also the orbital tissue, and of a dark color—often reddish blue. Additional benefit is derived from the external

application of cold compresses, wet with dilute phytolacca tincture, before the suppurative stage has been established. Later much relief will be obtained by the use of a poultice made from the phytolacca root.

Lachesis. — This remedy has cured a case of cellulitis following a tenotomy of the internal rectus muscle, reported by T. F. Allen, M. D. There was protrusion, chemosis and purulent discharge, with sloughing at the point of tenotomy, with a black spot in the centre of the slough. The retina was hazy and congested.

Hepar sulph.—For the suppurative stage or when it is inevitable. The lids are swollen, red and extremely sensitive to touch or cold applications. The pains are mostly throbbing.

Mercurius.—This remedy together with Hepar will shorten the suppurative stage, and after the pus has been evacuated, or as it becomes thin in character, the reparative process will be hastened.

Kali iod.—Very useful in those cases of partial orbital cellulitis occurring in young children of syphilitic constitutions.

Arsenicum, Bryonia, Silicia and Sulphur may do good service in some cases when used intercurrently.

PERIOSTITIS.

Periostitis may affect any portion of the orbital walls and may be acute or chronic.

Causes.—The causes which give rise to it are syphilis, injuries; periosteal inflammation of other cavities through continuity of tissue; exposure to cold in ill-nourished and low conditions of the system.

Symptoms and Diagnosis. — If acute it is difficult to distinguish from orbital cellulitis, with which it is always accompanied to a greater or less extent. The cellulitis is usually more localized, and the tendency to localization is greater the more chronic the periostitis. Where an acute periostitis arises from some lesion of the orbital walls the

periosteum is detached by the formation of pus beneath it. The displacement of the eye is in the direction opposite to the side affected, while the motion of the eyeball is limited in the direction of the side affected. If it arises idiopathically the tendency to the formation of pus is much lessened, and the eye is protruded more uniformly, with more or less loss of motion in all directions. Pressure upon the eyeball causes pain, which is more marked if the periosteal affection is located at the apex; if located near the margin or upon the walls, the pressure of the tip of the finger just within the orbital margin may determine the location of the lesion by the sensitiveness or swelling.

The chronic form is the more common and usually develops from injuries at periods more or less remote, or from syphilis. Its duration may continue for months, or years. The pain varies with the situation of the lesion, occasioning more suffering when located at the apex or margin than in other portions of the walls where the periosteum is more loosely attached. Exophthalmus and diplopia are commonly present, and in old cases a fistulous opening from the conjunctival sac, upon the surface of the lids, or upon the cheek, exists. Careful probing through this opening will reveal the roughened surface, or necrosis, of the bone.

Differential Diagonsis.—Periostitis is to be differentiated from orbital cellulitis by the more acute process of the latter, the greater protrusion of the eye, the loss of mobility and defective vision; from orbital tumors by the absence of pain and inflammation; from malignant growths by the early implications of the surrounding tissues and lids; from Basedow's disease by the staring appearance of the protruded eyes and the motion of the eyeballs.

Treatment.—This consists in the prevention of the extension of the diseased condition by the use of remedies, the early evacuation of the pus, thereby lessening further suppuration of the periosteum, and the improvement of the patient's general condition. In the acute forms the external applications of moist heat by hot compresses or poultices tend to lessen the pain but are usually of little value.

If the attack is acute the patient should be confined to bed, and the strength sustained by proper diet; in the more chronic forms the patient should be directed to use nourishing food, fresh air, and avoid exposure to cold or wet.

If it is probable from a careful inspection of the condition that pus is retained beneath the periosteum, it should be evacuated by the aspirator, or a free incision with the bistoury. The needle or knife should be passed close to the wall of the orbit and away from the eyeball. After the pus has been evacuated either spontaneously, or by the knife, a tent should be constantly kept in the wound so as to allow free drainage until the bone has healed. If a sequestrum forms, the external opening must be enlarged, and anti-septic injections employed, and the piece of dead bone removed. As the fistulous wound heals ectropium may result from the cicatrization. This may be partially prevented by narrowing the palpebral fissure one-third, or one-half, by the union of the lid edges after their scarification; the union being allowed to remain for three or four months, or until it is probable that there will be no further contraction of the wound. Later a subcutaneous separation of the cicatrix may be made with relief to the lid.

REMEDIES.

Asafœtida.—Proves very useful in relieving both the pain and inflammation of marginal periostitis. The parts around the orbit are blue, with great sensitiveness to touch.

Aurum mur. —Periostitis and caries with a tendency to exostosis in syphilitic patients; the pains are boring in character, excruciating and referred to the affected bone: nightly aggravation.

Kali iod.—Valuable in all forms of periostitis, but particularly so in the syphilitic variety. The pains are worse at night and vary much in character. In some cases the pain may be very slight. In its use the best results are obtained by the administration of five gr. doses, *ter in die*, and later of the 2nd or 3rd trit.

Ferrum phos.—This remedy produced rapid improvement in a case of localized periostitis occurring from a traumatic cause in a child of strumous habit. There was marked swelling of the lower lid and great sensitiveness, with ill-defined pains, febrile excitement and nocturnal aggravation.

Calc. phos.—As a nutrition remedy is often of much benefit in cases exhibiting slight reactive power, which may also require Silicia or Mercurius.

Mercurius.—Often indicated in cases of periostitis and caries, when the general cachectic condition presents the characteristic symptoms of the remedy.

Silicia.—In a condition of caries where fistulous openings leading to the diseased bone are present. The parts are hard, swollen, bluish-red, and the pus is usually offensive.

The following remedies may prove of service in individual cases: Calc. fluor., Nit. ac., Calc. carb., Hecla lava, and Sulph.

Caries and Necrosis of the orbital walls may result from periostitis or cellulitis, or take place in consequence of direct violence, particularly in strumous or syphilitic cases. The margin of the orbit is more frequently the seat of the trouble, owing to its exposed position. The lids become œdematously swollen, frequently completely closing the eye; the conjunctiva becomes inflamed and an abscess points upon the upper or lower lid near the outer canthus. On opening the abscess, dark-colored and badly-smelling pus is discharged and a fistulous opening remains. The abscess should be opened as soon as possible and a drainage tube introduced, and the dead bone removed as soon as loosened. The remedies likely to be used are those already mentioned under the head of Periostitis.

Capsulitis, or inflammation of Tenon's capsule, is a very rare disease. It presents slight protrusion of the ball, deep injection of the sclera, and accompanying chemosis of the conjunctiva with slight loss of motion in all directions. The absence of inflammatory changes in the cornea, iris or conjunctiva, will differentiate it from diseases of these tissues. The causes which produce it, are direct injuries to the capsule as in ten-

otomy for strabismus, or lacerations of the eyeball. It may complicate corneal, or suppurative keratitis, facial erysipelas, and result from suppression of the menses. It usually runs a mild course and requires for its treatment warm fomentations, with intervals of moderately tight bandaging. The remedies likely to be of service are Rhus, Bryonia, Phytolacca and Apis.

EXOPHTHALMIC GOITRE.

This disease, to which has also been given the names of Basedow and Graves, is characterized by a protrusion of the eyeball, due to vascular enlargement, hypertrophy of the thyroid gland, cardiac dilatation, and easily excited palpitation and frequent pulse. All these lesions may not be present in every case. Both eyes are affected, except in exceptionally rare cases. The disease is common to both sexes, but is more frequent in women. It is probably due to some disturbance of the sympathetic nervous system, and frequently arises from reflex irritation of the genital organs. It occurs about the age of puberty, but also with advanced age.

Symptoms and Diagnosis.—There may be a marked difference in the prominence of the two eyes, which present a peculiar stare, a portion of the sclera above the cornea being exposed by a slight retraction of the upper lid. Defective innervation of the ocular muscles is an early symptom and shows itself in the slowness of the levator of the upper lid to act in the vertical movements of the eyeball, infrequency and slowness of action in winking, overflow of tears and diplopia. The pupil is usually normal but may be dilated. The vision is not impaired, except in rare cases where the cornea suppurates from the exposure of the eyeball resulting from its protrusion and the retraction of the lids. In this case the attempt may be made to protect the eye from external irritation by bandaging the eyes, by the union of the lids, and if ulceration of the cornea supervenes, by treating it as described in the chapter on corneal diseases. The heart symptoms are accompanied by a rapid pulse which varies from 90 to 160, or more a minute,

and easily excited, and is associated with a flushed face, and a general hysterical condition of the patient. The enlargement of the thyroid, due to vascular engorgement, is usually seen in these cases, but may not always be present. The concomitant symptoms will readily differentiate the disease from other forms of exophthalmus. The disease is slow in its progress and after a time the heart symptoms may disappear and the patient recover, or the digestion may fail and the emaciation and prostration result in death from anæmia, asthenia, or phthisis.

TREATMENT.—For the exophthalmus nothing is necessary except to protect the exposed balls from external irritation as far as possible. If the cornea becomes dry vaseline applied to the ball several times a day may be of benefit, and bandaging is oftentimes a relief by making a gentle pressure upon the globes. It may be necessary to hold the lids in position by plaster, or make an operation for their partial closure.

Ulceration of the cornea is to be treated as directed in the chapter on corneal diseases.

Galvanism applied every other day, from five to ten minutes at each sitting, with the negative pole to the cervical region of the neck, and the positive pole alternately over the closed eyelids, the thyroid gland, and over the cardiac region, has been productive of much good in some cases. Rest, change of occupation, freedom from excitement, especially of the emotions, proper exercise in the open air and a generous diet without the use of any stimulants, may do much towards improving the condition of the case and result in success when combined with internal medication. The homœopathic treatment of the disease consists in the relief of the condition by a careful study of the totality of the symptoms presented. Those remedies which have been useful in the relief, or cure of cases, are Amyl. nit., Badiaga, Arsenicum, Iodine, Spongia, Cactus grand, Natrum mur. and Baryta carb. Other remedies have given relief to the heart symptoms and lessened the exophthalmus, as Bell., Brom., Calcarea, Phos., Sil., Sulphur and Ver. vir.

TUMORS OF THE ORBIT.

All portions of the orbit and its contents may serve as starting points for new growths, or the orbit may be invaded by tumors extending into it from the neighboring cavities. The amount and direction of the displacement of the eyeball from orbital tumors will depend upon the size and situation of the growths. If the tumor is located at or near the apex of the orbit, the eyeball is protruded directly forwards, the nerves and blood-vessels become compressed and the vision usually destroyed. If situated upon one of the walls the eyeball is displaced in a direction opposite to the tumor, with resulting strabismus; the loss of vision varying with the compression or extension of the growth to the optic nerve. If the tumor is located at the margin of the orbit, the displacement, or loss of vision may not occur. Tumors of the orbit may be divided into superficial and deep.

If superficial, they are generally fibrous, fatty, bony, or muscular. *Fibromata* are firm to the touch and found near the orbital margin; *lipomata* are usually seen beneath the folds of the conjunctiva on eversion of the lids. They generally start from the cellular tissue of the orbit and are benign. *Osteomata* are very hard to the touch and slow of growth. *Angiomata* more frequently arise from nævi which grow backward from the skin of the lids into the cellular tissue of the orbit. *Cystic tumors* containing cheesy or fatty matters, albuminous fluid, blood, or hair, are not infrequently met with in the orbit. If not too deep they may be felt as elastic and slightly movable masses; they are usually slow in progress. Degenerations of the lachrymal gland may present either a superficial or deep growth. *Hydatids* enclosed in capsules, *echinococci* or *cysticerci* are found in the orbit and may be superficial or deep. These are all slow and painless growths unaccompanied by inflammatory symptoms.

The deep-seated tumors may consist of any of the varieties already enumerated or present the features of malignant growths. They may arise in the orbit or puncture its walls

from the surrounding cavities or from the eyeball itself. Beginning protrusion of the eye gives often the first indication of their presence. If the growth of the tumor is slow the lids undergo remarkable distention as the globe advances, or they become widely separated and no longer give protective covering to the cornea which may suffer in consequence and become inflamed or suppurate. Again, the globe may be pushed out on to the cheek, the lids everted and the eye entirely lost. In the deep-seated growths, the displacement of the eye becomes very marked and the sight almost always destroyed. Malignant tumors are characterized by a more rapid growth, and unnatural vascularity of the surrounding integument and enlargement of the veins, and are commonly of the sarcomatous, medullary or melanotic varieties, and usually involve the eye. Either form on reaching the surface extrudes between the lids, becomes fungoid, bleeds easily, is covered by an offensive secretion, emits a sickening odor, and death is produced by hectic emaciation or exhaustion.

Malignant growths are much more common in children than in adults, though occurring in each of them. Fibromata, lipomata, angiomata, cystic and less malignant growths increase in size much more slowly and prove more amenable to treatment.

Diagnosis.—The diagnosis of the character of orbital growths is accomplished with the greatest difficulty, and, except in some cases of malignant and bony tumors, can only be made during the process of removal. It is always uncertain, and the general condition of age, sex, condition of health, cancer heredity, or the presence in other organs of cancerous affections, struma, syphilis, the location of the tumor, its probable place of origin, its rate of progress, the presence or absence of pain and inflammatory symptoms, the involvment of the ocular muscles and the condition of the vision and optic disc, all must be considered in endeavoring to make a diagnosis. The pressure of the finger around the globe within the margin of the orbit may give some idea as to the mobility, hardness, and possible location of the tumor upon the muscles or walls of the orbit. The prognosis depends upon the nature

of the tumor, whether benign or malignant, and whether it can be removed without the loss of the eyeball.

Cystic tumors are partially movable; bony tumors, on the other hand, are very hard, resisting, and immovable. The loss of vision depends upon the involvment of the optic nerve in the tumor. An ophthalmoscopic examination of the affected eye should always be made. Optic neuritis followed by atrophy is present when the optic nerve is involved in the tumor. If optic neuritis is present in both eyes, or choked disc in the otherwise well eye, the tumor is undoubtedly intra-cranial.

Cartilaginous and *bony tumors* generally follow periostitis or ostitis in strumous or syphilitic subjects, or they may have a traumatic origin. Pain and inflammatory symptoms are absent unless periostitis also exists.

Fibrous tumors are hard to the touch and incompressible, non-inflammatory, and incased in a connective tissue sheath; on dissection a gray, yellow or brown basis substance is seen traversed by white opaque bands. Removal becomes very difficult when situated deeply in the orbit.

Sarcoma of the orbital tissues is of frequent occurrence and may arise from any portion of the orbital tissues, its more common seat being the periosteum. It may be congenital and exist for some time without exhibiting any rapid growth, until, from some unknown cause, it begins to increase rapidly. Orbital sarcomata rapidly excite new foci and infiltrate surrounding tissues or more distant organs. The characteristic feature of the sarcomatous tumor is the preponderance of the cellular elements, which consist of hypertrophied connective tissue cells. The cells are either round, stellate, or spindle shaped, and form with the entire cellular substance a tolerably firm mass. Sarcomata may acquire a medullary, or, if the cells are filled with pigment, melanotic condition.

When the sarcoma has its origin in the optic nerve, or retina, and involves the orbit, it appears as glio-sarcoma. The large celled, especially the spindle and giant celled sarcomata, are less fatal than the small round celled variety, while the melan-

otic variety is particularly infectious. It may be confounded in its early stages with a node, but the absence of syphilitic history will decide the matter. The soft and smoother surface of the growth precludes the supposition of an exostosis. These tumors, although appearing as small, hard, nodulated masses, form extensive attachments to the orbital cells; if undisturbed, they grow steadily until the overlying skin ulcerates and the patient's health fails.

Cancerous tumors are very malignant and the infection rapidly spreads, involving all the tissues of the orbit and the surrounding cavities. The lymphatics become infiltrated early and the cancer cells are carried to other parts. The protrusion of the eyeball is less with scirrhus than with other tumors, the walls of the orbit being rapidly absorbed; the tumor invades the surrounding cavities, and pressure is not exerted upon the eyeball. The tumor presents a firm resistance and may be mistaken for an exostosis.

Vascular tumors are of comparatively rare occurrence; they form in the cellular tissue of the orbit and increase slowly and usually do not impair the patient's health or vision. The protrusion disappears on pressure and reappears when the pressure is removed. It becomes larger on straining, stooping, or crying, and often a slight pulsation is present which is not perceptible to the patient. They may be caused by intra-cranial affections which interfere with the return circulation by pressure on the ophthalmic vein. The diagnosis is usually very difficult.

Treatment.—The treatment consists in the early removal of the growths when practicable, and time should not be lost by unavailing medication. Those tumors which are situated more superficially may be removed either through the conjunctival sac, or through the attachments of the lids without interfering with the eyeball, by an incision parallel to the orbital margin and over the most prominent point of the tumor; all bleeding must be arrested before the wound is closed, and all clots removed by washing out the wound with boracic acid solution. If cellulitis results, ice applications

may prevent its extension and lessen the reaction. When situated at the upper margin of the orbit, ptosis results from the incision which divides the levator, or the removal of a portion of the muscle with the tumor.

Cystic tumors may be evacuated by an incision, or with the aspirator, and irritating injections be made into the cystic sac, resulting in a union of the cyst walls and obliteration of the tumor. Fatty tumors may be removed without danger, unless the extension is very great. Bony tumors, which often grow to great size, in rare cases yield to iodide of potash, and are difficult to treat, for resection is fraught with peril, as the full extent of the disease is uncertain and frequently involves the osseous protection of the brain. When their removal is attempted, as when the margin alone appears involved, the careful separation with a chisel and mallet is necessary.

In all cases the question arises as to the removal of the tumor without destruction of the eyeball, or, the removal of the whole of the contents of the orbit. If the tumor does not penetrate too deep and is bony, the eyeball may usually be saved. In the removal such muscles as are necessary may be severed from the globe, a black suture being passed through them until after the removal of the growth, when they are to be united in proper position to the eyeball. If the tumor is malignant or deep, and involves much of the contents of the orbit, the vision is already destroyed by involvment or compression of the optic nerve, so that the removal of the eyeball and the whole of the contents of the orbit is necessary. When it becomes necessary to remove the eyeball to get at the tumor, the growth if bony is to be removed with as little destruction of the orbital tissue as possible, so as to leave sufficient cushion for the wearing of an artificial eye.

When the tumor is malignant or the eyeball involved, the whole of the contents of the orbit are to be removed, leaving the periosteum undisturbed, if after close inspection it is not found involved.

The *operation for the extirpation of the contents of the orbit* is performed by slitting the lids at the outer canthus, and,

having the lids retracted by the fingers of an assistant, introducing a pair of blunt scissors between the tumor and the orbit, and by slowly cutting, pushing and tearing while keeping close to the orbital wall, the tumor is freed from the surrounding tissues up to the apex of the orbit, when the mass may be torn from its attachment there. The hemorrhage will depend upon the vascularity of the tumor and the amount of cutting in the dissection, but is most profuse when the tissues are separated at the apex. It may be necessary to stop the hemorrhage from the ophthalmic artery by torsion, but it usually retracts into the foramen, and if the bleeding continues the apex of the orbit may require packing with styptic cotton, which is retained by absorbent cotton tightly packed upon it, and a compress bandage applied. In some cases where the periosteum is involved, the walls of the orbit should be washed with a solution of chloride of zinc, or a paste of flour and chloride of zinc, four parts of the former to one of the latter, applied to the infiltrated parts. Suppuration necessarily follows, and daily washing of the cavity with antiseptic lotions will be necessary, and the orbit finally fills with granulating tissue. The growth may reappear after the most painstaking removal and require a secondary operation, when the bony walls should be scraped, or the chloride of zinc paste reapplied. The wearing of an artificial eye is not practicable after extirpation of the contents of the orbit, as the granulating mass does not, except in rare cases, become covered with epithelium from the remaining conjunctiva of the lids, and ptosis results from the excision of the levator.

Diseases of the Blood-vessels of the Orbit.—Aneurism of the ophthalmic artery and diffuse aneurism of the orbit, vascular growths, varices of the veins, and thrombus of the cavernous sinus, all produce what is termed *pulsating exophthalmus*, protrusion of the eyeball which is accompanied by pulsation. The cases are rare and arise spontaneously or from injury. The diagnosis of the particular lesion producing the exophthalmus can only be made approximately. It develops rapidly and the protrusion varies in degree. There is slight or

no pain, but weight or pressure in the orbit is complained of, and the pulsation and bruit become annoying. The pulsation is early discernible, being apparent to the observer on ocular inspection, or to the touch, while with the stethescope placed over the closed lids or upon the upper margin of the orbit a distinct bruit is heard. When compression of the carotid diminishes or stops the pulsation, digital compression or the ligation of the internal carotid may relieve the trouble. Injections into the cavity of the orbit are fraught with much danger and rarely do good in these cases. Electrolysis affords better results.

Diseases of the Cavities Surrounding the Orbit.—Diseases of neighboring sinuses frequently produce disturbance of the orbital tissues and exophthalmus. Distension of the frontal sinus by mucus, or pus resulting from injury, as a blow upon the face which has fractured the ethmoidal, or frontal cells, may cause a closure of the connecting channel between the sinus and the nose, while the distended sinus encroaches upon the orbit. The accumulating secretion gradually distends the sinus until the thinnest portion, the roof of the orbit, yields and is pressed down into the orbit, and displaces the eyeball downward and outward; this may arise from closure of the infundibulum in old catarrhal cases. Pain and inflammation may result, and the pus be discharged into the nares by the reopening of the infundibulum. If this does not occur it requires the introduction of a knife along the upper wall of the orbit, a careful dissection of the parts, and after the dependent portion of the bone is exposed, a strong knife is passed into the sinus and the pus removed; or a curved trochar or bistoury is introduced through the sinus, while the little finger is passed up the corresponding side of the nose and furnishes a guide for the passage of the bistoury, or trochar, into the nasal cavity through which the pus is discharged. A lead wire, or rubber drainage tube, is passed into the opening and kept in position until the discharge from the nose has ceased. The cavity should be washed daily with some disinfectant and astringent solution.

In two cases where the protrusion was only moderate, I have obtained a cure by the use of Hepar and Silicia, together with the packing of the upper portion of the nose with glycerine tampons. Growths, or accumulation of fluid, in the antrum, more frequently encroach upon the orbit than in other directions, and displace the floor of the orbit upwards. The deformity of the side of the face accompanying the distention of the antrum will render the location of the lesion easy.

Injuries of the Orbit have already been considered in the chapter devoted to Injuries of the Eye.

CHAPTER VIII.

DISEASES OF THE LACHRYMAL APPARATUS.

ANATOMY.

The parts which constitute the lachrymal apparatus are: the gland found at the upper and outer side of the orbit, which secretes the tears, with its excretory ducts; the two canals near the inner angle, into which the fluid is received, and the sac, continuous with the nasal duct through which the tears pass into the inferior meatus of the nose. The lachrymal gland, in minute structure similar to the salivary glands, is an oblong flattened body about the size of an almond, lodged in the upper and outer part of the orbit in a slight depression in the orbital plate of the frontal bone, to the periosteum of which it adheres by fibrous bands; the lower surface of the gland is adapted to the convexity of the eyeball. The anterior part of the gland is separated from the rest by a thin layer of fascia, and is sometimes described as the inferior lachrymal gland. It is closely united to the back of the eyelids and presents small lobules which open by separate ducts directly upon the conjunctiva. These ducts from both portions of the gland are very minute and from twelve to fourteen in number opening in a row in the superior folds of the conjunctiva near the temporal side, and the tear fluid is distributed over the eye and collected at the caruncula lachrymalis. On the margin of each lid (Fig. 55), near the inner angle of the eye, is a small elevation directed against the eyeball and traversed by

a minute aperture, the punctum lachrymalis, these openings being the commencement of the two canaliculi, narrow canals which convey the tears to the lachrymal sac.

The lachrymal sac and the nasal duct together form a passage about one inch long by which the tears reach the nose. The lachrymal sac presents an expanded portion rising above the entrance of the canaliculi, and is located in the depression formed by the lachrymal and superior maxillary bones, being covered posteriorly by the tensor tarsi, anteriorly by the tendo oculi and fibres of the orbicularis muscle. The sac is composed of fibrous and elastic tissues adhering closely to the bones above mentioned, and is lined by a mucous membrane which is very vascular and covered by cylindric epithelium. The duct, which is continuous with the sac, occupies the canal (*d* Fig. 56) formed for it in the superior maxillary bone and is lined by the mucous membrane which is continuous with that of the nose and sac, which partakes of the character of the periosteum and mucous membrane, the cylindric epithelium of the duct presenting ciliated processes. It opens beneath the inferior turbinated bone *b* as a narrow slit, as shown at *e* in Fig. 56, where the anterior half of the turbinated bone has been cut away. As the sac joins the duct we find the mucous membrane thrown into folds, and again at its middle portion, and at its terminus in the meatus. The tears in their passage over the conjunctiva and eyeball are mostly evapo-

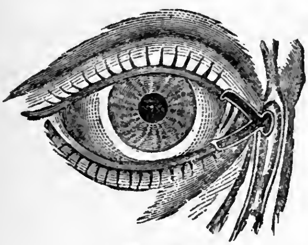


FIG. 55.

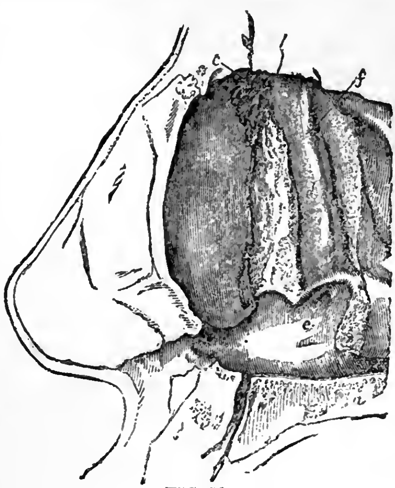


FIG. 56.

rated, the excess being taken up by the puncta by suction caused by the minute muscular fibres which surround the puncta and canaliculi, and having reached the sac is forced into the duct by the action of the orbicularis and the tendo oculi during the action of winking, when the fluid finds its way into the nasal meatus by gravity aided by the ciliated epithelium.

DISEASES OF THE LACHRYMAL GLAND.

DACRYO-ADENITIS.

Acute inflammation of the structure of the lachrymal gland occurs as a result of injuries of the upper and outer angle of the orbit, is more frequent in children than in adults, and occurs more often in women than in men. It is characterized by tenderness, pain, local heat, swelling and redness of the contiguous parts. It is liable to be mistaken for a periostitis. It may end in resolution or suppuration; if the latter occurs the pus is discharged through the conjunctival sac, or may point on the upper part of the lid; in either event a fistulous opening is apt to remain for some time, discharging pus and lachrymal fluid.

Dacryo-adenitis is more frequently of a *chronic* character and runs a very tedious course. The causes are the same as those giving rise to the acute form. It is usually manifested by a gradual enlargement of the gland which can be easily recognized by its lobulated border, but is not readily distinguished from morbid growths in the gland or tumors of the same region of the orbit. In either form, if the enlargement is great, the eyeball is displaced downward and inward, and the superior folds of the conjunctiva are pushed forward so as to lie between the globe and the upper lid. The tumor is not painful or sensitive to touch unless the inflammation is acute.

The *accessory glands* are sometimes the seat of suppurative inflammation. The swelling and tenderness does not extend over so large an area as when the gland is involved, and on everting the lids one or two small, yellowish points are discovered in the retro-tarsal folds above the tarsal cartilage.

TREATMENT.—In the acute form, Aconite and Bell. with cold compresses may cause resolution. If suppuration is threatened then hot fomentations and poultices will be required, and as soon as pus is formed an incision should be made for its release, as a fistulous opening is less likely to remain than when the abscess is allowed to break spontaneously through the skin. Hepar s., Merc. and Silicia are the remedies likely to be indicated during the suppuration. In the chronic form the enlargement may be reduced by such remedies as Baryta iod., Kali iod. and Phytolacca. Extirpation of the gland will usually be necessary, the operative procedure being the same as that for a tumor of the corresponding locality. It should be borne in mind, however, that in dissecting out the gland in cases of hypertrophy, it will be found to extend very deep into the orbit along the roof.

Functional diseases of the gland are rare, but some cases occur in which there is hyper-secretion. In one case a cure resulted from the internal use of Ignatia in a myope who had suffered for years from periodical attacks of lachrymation, the attacks lasting from three to four hours at a time.

DACRYOPS.—The distention of one or more of the ducts of the gland may occur from closure of the conjunctival opening. In this case a small bluish tumor (*dacryops*) the size of a pea will appear beneath the conjunctiva on the eversion of the lid. The remedy is excision of a portion of the cyst wall.

TUMORS OF THE GLAND.—The lachrymal gland may be the seat of sarcomatous and other morbid growths and cystic degeneration. In this case the removal of the gland is demanded. Destruction or removal of the gland does not produce a dry condition of the eye, because the glands and mucous follicles of the conjunctiva are sufficient to keep the eye moist.

EPIPHORA, or watery eye, is a term which should be restricted to the simple overflow of tears onto the cheek from hyper-secretion; the term *stillicidium lachrymarum* being applied to those cases where the flow into the nose is obstructed, and *lachrymation* being an increase of the tear fluid caused by

reflex action from irritation of the ciliary or sensitive nerves, as in superficial inflammation of the eyeball or irritation from minute foreign bodies on the cornea or conjunctiva.

Lachrymal Strictures, obstructions to the flow of tears, are very common and may occur at any portion of the lachrymal conduits and may affect those of both eyes, or of only one side. In the examination of the case, the first point to be determined is the *condition* and *position of the puncta.* If these are closed or directed upward or outward, so as not to receive the tears, the fluid collects in the palpebral fissure and drops over the lid edge upon the cheek. When this condition

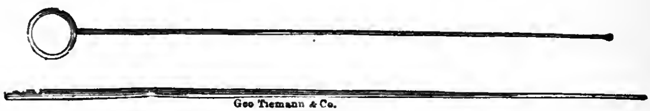


FIG. 57.

has existed for a time, conjunctivitis, or blepharitis results from decomposition of the fluid and subsequent irritation. *Occlusion* of one punctum may cause little or no annoyance from epiphora, the tears being carried off by the other. If troublesome, however, the punctum may be opened by means of a pin, and kept open by the use of Anel's canaliculus probe. (Fig. 57.)

The causes which give rise to obstruction at this point are usually chronic inflammation of the lid borders resulting in thickening, chronic inflammation of the conjunctiva, as granular lids and paralysis of the facial nerve which causes a loss of the compressing and sucking action in winking, and a slight falling away of the lid from the globe. The remedy consists in the opening of the puncta and division of the canaliculus, except in paralytic cases.

The *operation of slitting the canaliculus* is performed on the lower canaliculus by dilating the punctum by a fine probe-pointed knife, as Weber's (Fig. 58), or, if the opening is much narrowed or occluded, the lachrymal eminence can be discovered with a little care, and the point of a needle or pin inserted, and the punctum stretched so that the probe point of

the knife may be introduced. The patient is seated, and the operator stands behind and supports the head on the chest; the lower lid is drawn tightly outward and slightly everted by the thumb, the point of the canaliculus knife introduced into the punctum in a vertical direction and then turned horizontally and passed through the canaliculus, the cutting edge being directed slightly inward and upward until the inner wall of the lachrymal sac is reached, and as the handle of the knife is raised towards the median line of the head the canaliculus is divided to its entrance into the sac. The line of the incision should lie at the inner edge of the free margin of the

FIG. 58.

lid, as in this direction the opened canaliculus more readily receives the tears to convey them to the nose. This must be kept open by the daily passage of a small probe until a gutter remains instead of the closed canal. In paralytic cases opening the upper canaliculus affords better chances for relief. In this case the canaliculus knife is introduced into the punctum, the upper lid being put on the stretch, and the knife passed upward and inward and the canaliculus split upon its edge.

Causes of Stricture.—The causes of lachrymal stricture are various; the presence of foreign bodies may excite inflammation, wounds and the resulting cicatrix, and the extension of chronic catarrhal conditions of the nose and conjunctiva. Injuries of the lids in the region of the canaliculi usually cause stricture and require slitting of the canaliculus. Foreign bodies may fill the canaliculus and thus cause obstruction. These may be hairs, cilia, chalky deposits, or fungous growths of leptothrix; the former should be removed, and if the latter cannot be pressed out the canaliculus should be opened up and the bluish mass removed, and injections of boracic or weak carbolic acid used until all vestiges of the vegetation have dis-

appeared. The most frequent cause of obstruction to the lachrymal flow are strictures of the lachrymal or nasal duct.

Symptoms of Stricture.—Besides the overflow there is frequently a small tumor-like prominence of the lachrymal sac to the nasal side of and just below the inner canthus, which is termed *mucocele.* (Fig. 64). Pressure upon this causes a filling of the inner canthus with viscid mucus or muco-pus, mixed with tears, through the canaliculi and puncta.

Varieties of Stricture.—Strictures may be of three varieties, *mucous*, *fibrous* and *bony.* The mucous form is occasioned by folds of the mucous membrane lining the sac becoming thickened by inflammatory action extending from the nose and causing a union of the opposite walls, either at the nasal opening, at the junction of the nasal and lachrymal ducts, or in the lachrymal sac. In this case, the application of glycerine by a camel's hair brush, or a cotton tampon saturated with glycerine, to the parts about the middle turbinated bone of the affected side, will relieve the hyperæmia and cause a re-opening of the duct in many cases. If the union of the surfaces is strong, the operative procedures necessary for the fibrous form will be demanded. The fibrous variety results from long-continued inflammation, more or less chronic, which implicates the outer, fibrous, layer of the duct. An ulcerative process is often present in these cases and several fibrous bands of various widths in different portions of the duct result. These strictures may be single or multiple and may be found in any portion of the duct or lachrymal sac. Bony strictures arise from slow inflammatory affections of the periosteum which may cause a filling up of the canal at some portion, or its more or less complete obliteration. The most frequent seat of these strictures is at the junction of the lachrymal and nasal ducts. The bone is often denuded of the periosteum and feels roughened under the probe.

Treatment.—Bony strictures are usually forlorn cases, as they are impermeable. Various operations have been proposed and attempted for the relief of these cases, but without satisfactory results. There is a field here for the application

of the internal remedy. In one case, due to osseous closure, the administration of Hecla lava, 6x trituration, caused sufficient absorption to allow of the passage of a No. 2 Bowman's probe. In cases of caries, Silicia, Kali iod. and other remedies may improve the condition. In the treatment of all forms of lachrymal obstruction, the first thing to be done is to improve the condition of the mucous membrane lining the passages by the use of such remedies as Petrol., Arg. nit., Stannum, Pulsatilla, Silicia and Merc., when the puncta or canaliculi are not at fault. The patient should be directed to press gently upon the mucocele as frequently as it appears, and having removed the accumulation from the inner canthus, a lotion of borax gr. x ad f℥i, calendula ø gtt. xx ad f℥i, or boracic acid gr. v ad f℥i of water. If the canal does not become patent after such treatment has been employed or acute inflammatory symptoms supervene, then the canaliculus must be slit up and the stricture divided and the probe introduced. (Fig. 59) For the division of the stricture and the passage of the probe the canaliculus is to be slit up in the manner already described and the stricture incised with either a Weber (Fig. 58), or Bowman, canaliculus knife, although they are usually too slender to use with safety. The better method is to open the canaliculus and holding a small probe, either Bowman's No. 1 or 2 (Fig. 61), parallel with the margin of the lower lid, the point is introduced into the opened canaliculus and carried inward until it rests upon the lachrymal bone; if puckering of the lid at the inner canthus results, the opening of the canaliculus into the sac has not been divided, and the opening must be made larger; the probe is then brought into a vertical position and the attempt made to follow the direction of the duct, which is downward, outward and slightly backward. The curve of the duct, however,

FIG. 59.

varies somewhat in different individuals and the particular curve must be determined. If the stricture is not dense, moderate pressure may cause sufficient dilatation of it to allow the passage of the probe. The most important point to be observed is that the probe engages in the upper part of the nasal duct in the opening in the superior maxillary. The danger is that the probe may pass over the edge of the opening to the inner side and a false opening be made into the nose, or to the outer side, and hemorrhage or emphysema of the orbital tissue result from a laceration of the sac at this point. The probe passed into the canal enables us to locate the position and determine the kind of stricture to be dealt with. If the stricture is not separated by the passage of the

FIG. 60.

probe, and is found not to be bony, it may be divided by the Agnew, Knapp, or Noyes, knife with a pliable shank, introduced in the same manner as a probe to the seat of stricture when it is divided by passing it through it; or the operation of Stilling which is made with a much stronger knife (Fig. 60.) which is passed down in the same manner, and pushed through the stricture, and then partly withdrawn and turned in other directions and pushed down again until the stricture is divided in several places. There is generally bleeding from the nose which is an indication that an opening has been made through the stricture. The immediate passage of the probe will depend upon the ability of the patient to sustain further pain. If an anæsthetic has been used, my practice is to pass as large a probe as possible and allow it to remain for a few moments while the patient is recovering from the anæsthetic. If it is not desirable to probe the canal at the time of division of the stricture, the patient is directed to apply cold dressings to the eye, and take Aconite internally for twenty-four hours when, if the parts are not very painful, the probe may be inserted. The canaliculus must be kept from

healing by the daily passage of the probe, and this should be introduced the full length two or three times a week, allowing it to remain ten or fifteen minutes at each sitting. In regard to the maximum dilation which should be produced by probes,

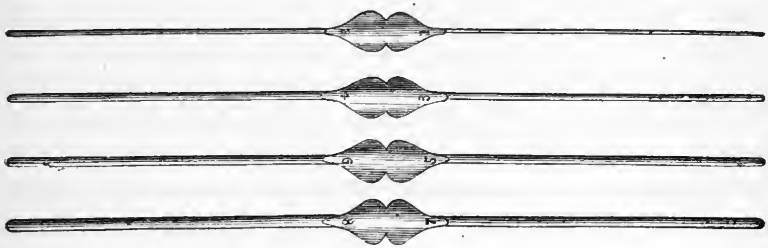


FIG. 61.

surgeons differ; except in rare cases, I have found the No. 8 of Bowman to suffice; occasionally benefit may be derived from a Theobold No. 10, where there is a decided tendency to recurrence of the stricture, though I deprecate the forcible

FIG. 62.

distention by such large probes, as they are usually productive of more harm than good. The Bowman probes (Fig 61), which come in sets of four, numbered from 1 to 8, are straight when received from the instrument makers, and should

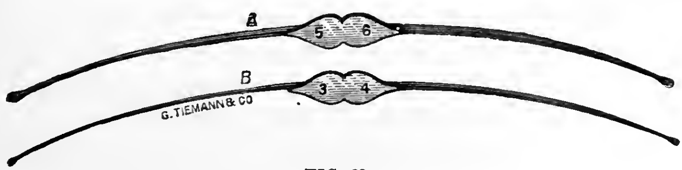


FIG. 63.

be curved to correspond with Weber's (Fig. 62), which is a conical probe increasing rapidly in diameter from the point; but this curve will also have to be modified to suit the sinuosities of the duct in individual cases. In some cases the bulbous pointed probes of Williams (Fig. 63) will be found very useful.

Electrolysis.—In the *Transactions of the Am. Hom. Oph. and Otol. Society for 1879*, I advocated the use of the galvanic current for the solution of lachrymal strictures, as the continued use of it in the treatment of obstinate cases had been eminently successful in my hands. In the records of eighty-seven cases treated in this manner, I find nothing distinctive as regards the cases. Many of them had already been subjected to Bowman's or Stilling's operation and the various methods of injection. They were all chronic cases with the canaliculi slit up, and many of them had had operations upon the stricture previously without permanent result. The majority were women on whom it was difficult to use the knife or even the probe, from hyper-sensitiveness, but who submitted without trouble to the use of electricity, although accompanied with more or less pain. For the treatment of these cases insulated probes of the size ordinarily used are required. The points of the electrodes should be olive-shaped, and the insulation smooth, hard and pliable, not causing any increase in the calibre of the probe, and extending to within 2 mm. of the point. The electrodes for the ducts must first be introduced into the sac down to the seat of stricture and then connected with the negative pole of the battery by an insulated wire. The number of cells must be determined by the operator in individual cases, and depends upon the strength of the battery and the position of the positive pole, whether in the hand or upon the cheek of the patient. Five to fifteen Siemen's and Halske's small cells are generally sufficient for the purpose. Great care must be exercised here as elsewhere not to use a current of such strength as to produce an eschar. The length of time and the frequency of the sittings must depend upon the amount of irritation produced. In the cases treated, the current was used from two to three minutes at a time and at intervals of two or three days until I was able to pass the largest probe, when the sittings occurred only every week or two weeks. When the strictures are very firm and numerous I have made several applications before passing through them, afterwards using larger electrodes until

the largest lachrymal probes were passed without difficulty. The solution of the strictures was not the only good result attained by the use of the galvanic current in these cases, as the improved condition of the mucous membrane was apparent after a few applications, by the prompt relief of the blennorrhœa.

When the patient resides at a distance and cannot remain for sufficient time to produce a cure, if the duct tolerates the probe well a lead wire probe may be introduced and allowed to remain for some weeks, the upper end of the wire being bent over and turned so as to lie in the slit canaliculus or project one eighth of an inch on the side of the nose, the patient being directed to remove it if it should become uncomfortable. During the time that the probing is carried on, the sac and duct must receive attention tending to improve their condition. The close prescription of remedies and the use of injections with a lachrymal syringe, after the passage of the probe, will materially hasten the cure. In the use of the syringe, the barrel having been filled with the lotion, the point of the syringe is passed into the duct in the same manner as a probe, the piston pushed down and the fluid forced into the nose whence it drops, as the patient leans forward, into a cuspidor conveniently placed. Many lotions have been recommended for use in this way, and some may possess certain advantages in special cases. The most useful for the majority of cases will be boracic acid gr. iv ad f℥i. Injections of tannic acid and glycerine gr. xv ad ℥j diluted, or arg. nit. gr. i-ii. ad f℥j may be also used. Under this treatment the discharge diminishes and, in a short time, the probe becomes necessary only at longer intervals, but will have to be continued for a long time even after an apparent cure has been accomplished. If all treatment fails, or if the duct is absolutely impermeable to the probe, the sac may be destroyed by opening it freely just below the inner canthus, and cauterizing the interior by the galvanic cautery, chloride of zinc or nitrate of silver, but the results are by no means satisfactory. The comfort of the patient may be more readily obtained by excision of the lachrymal gland.

DACRYO-CYSTITIS.

CAUSES.—Acute inflammation of the lachrymal sac and duct occurs by extension of diseases from the conjunctiva through the canaliculi, or as incidental to chronic catarrhal conditions of the nostril or of the lachrymal duct, and the closure of the canaliculi in cases of stricture of the duct with distention of the sac.

SYMPTOMS.—The attack may be preceded by a chill, and is attended with severe pain, tenderness and slight swelling of the sac, often accompanied by considerable fever and constitutional disturbance. The condition is recognized by the presence of a small, hard and painful tumor at the nasal side of the inner canthus, which, as the inflammation progresses, becomes tense and shining, and the swelling extends to the cheek and eyelids, the latter becoming so œdematous as to prevent their being opened. The whole side of the face may become involved in the phlegmonous inflammation and the attack may be mistaken for one of facial erysipelas. If the inflammatory process is unchecked, an abscess forms in the sac and fluctuation may be felt; the pus points outward, and, if left alone, discharges through an opening in the skin; after a short time the swelling subsides, the canaliculi again open and the parts return to their normal condition. It more often happens when the disease is allowed to run its course that it terminates in a *lachrymal fistula;* the tears which enter the sac again pass out through the opening made by the abscess, mixed with mucus and pus. This may close after a time and abcesses frequently recur. Occasionally caries or necrosis of the lachrymal bone results in syphilitic or scrofulous patients.

TREATMENT.—At the commencement of the inflammation it may be possible by the use of cold compresses, or ice bags, together with the internal administration of Acon., Bell., or Verat. vir. to abort the attack. The surer means of doing so, however, lies in the immediate slitting up of one or both canaliculi, before the œdema of the lids has become so great as to make it impossible. The divided canaliculi will give

vent to the imprisoned contents of the sac, and the inflammatory symptoms will subside rapidly with the treatment above indicated. As soon as pus forms in the sac, the temperature of the topical applications must be changed and hot fomentations of calendula decoction or diluted tincture of veratrum vir. (gtts xx ad f℥i) applied continuously, together with the internal administration of Hepar, Puls. or Silicia as may be indicated, and as the swelling of the lids is usually too great to allow of the opening of the canaliculi without an anæsthetic, a free incision must be made with the bistoury directly into the sac and the pus allowed to escape; the hot compresses may be continued for twenty-four or forty-eight hours when the acute symptoms have about subsided. As soon as this result has been attained, an effort must be made to close the fistulous opening which will, usually, occasion little trouble, if a free passage to the nose is established by the removal of any stricture of the duct which may be present, with the probe or knife,

In the treatment of the lachrymal fistula, after having removed any obstruction to the flow of tears through the lachrymal duct, the edges of the fistulous opening should be touched with nitrate of silver. If polypoid granulations spring from the opening, benefit will be derived by filling it with alumen exsiccatum pulv. In some cases the edges of the fistulous opening will require paring and the subsequent application of pressure at the opening, which may be made by the application of a cork on the end of a spring band which is riveted to a band passing round the forehead. Certain remedies have been reported as having cured cases of lachrymal fistula without operative interference, but in my hands, after a thorough trial, have given no result.

DACRYO-CYSTO-BLENNORRHŒA.

Catarrhal inflammation of the lachrymal sac and duct is generally a secondary affection due to an extension of the catarrhal inflammation from the nose or conjunctiva, and rarely comes for treatment until after the duct has been obstructed.

SYMPTOMS.—At first there is a slight uneasiness at the inner canthus to which little attention is paid. Exposure to cold or windy weather causes the tears to run down the cheeks. This condition of things may last for months, the flow of tears becomes more constant and requires the frequent application of the handkerchief during the day. In course of time a thick mucous discharge appears at the inner canthus; this changes to a purulent secretion, and, if neglected, the disease may progress and gradually distend the lachrymal sac. The mucous membrane lining the sac becomes swollen and all its layers hypertrophied, the nasal portion of the duct occluded by the formation of a stricture, and the sac gradually fills and becomes distended and presents as a *mucocele*, (Fig 64). The patient soon learns that by pressure upon the sac the contents are forced down into the nose or into the eye; in either event, the sac is emptied and a repetition of this as often as the sac fills, affords considerable relief. The disease is slow in its progress and for a long time causes but moderate annoyance, but after the mucocele has formed, if the sac is not constantly emptied, the accumulated secretion decomposes and becomes irritating, and when brought in contact with the conjunctiva brings on an attack of conjunctivitis. The inception of cold in this condition causes an increased secretion, further swelling and an attack of phlegmonous inflammation of the sac; and abscess or fistula follow.

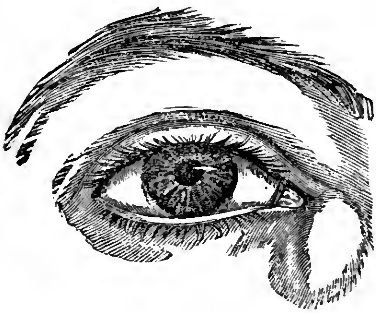


FIG. 64.

In general the disease is very protracted and in spite of the best and most patient treatment proves obstinate and intractable. In the majority of cases the progress under treatment is so slow that patients become discouraged, or are unwilling to take the time for proper treatment, and the surgeon does not have the opportunity to continue effectual treatment for a sufficient length of time to bring about a cure.

The presence of any lachrymal disease contra-indicates any operations upon the cornea or iris, owing to the great danger of infection of the wound from the purulent secretions, hence it follows that all cases requiring operations for cataract or iridectomy demand a previous cure of the lachrymal trouble.

TREATMENT.—Where the catarrhal condition is dependent upon stricture of some portion of the lachrymal passages, the first indication for treatment lies in the relief of the stricture in the manner already described. Patients will not always consent to the most rational and rapid methods of relief in these cases. They should, however, be directed to keep the sac empty by firm, slow pressure upon it with the tip of the finger, so as to force the accumulation into the nose or through the canaliculi into the inner canthus where it is absorbed by gentle pressure with the handkerchief, and immediately afterwards a few drops of a solution of borax (sodæ biboratis gr. v.—x ad f℥i) may be dropped into the inner canthus and on the relief of the pressure of the finger made to enter the sac. To keep the irritation at the minimum, the sac must not be allowed to become distended, and all rubbing of the lids should be avoided. Care should also be taken to avoid exposure of the eyes to cold winds or over-taxation. The condition of the mucous membrane of the eyes must also receive attention, as the improvement of the nasal catarrh, or ozæna, oftentimes results in a marked improvement of the condition of the sac. The internal remedies which have proved of value in the treatment of catarrhal and blennorrhœal conditions of the lachrymal sac are:

Aconite.—Indicated when the mucous membrane presents the same hypertrophied condition which was present in the conjunctival affection which precedes or accompanies it.

Euphrasia.—Indicated in similar conditions to Aconite and frequently follows the latter when the discharge becomes thick, yellow and acrid.

Pulsatilla and *Calc. carb.*—When there is a profuse, thick and bland discharge. The concomitants deciding the choice.

Argent nit.—Catarrh of the lachrymal sac, when the dis-

charge is profuse and the caruncle and semi-lunar folds appear red and inflamed.

Petroleum.—This remedy has a marked action upon the mucous membrane of the lachrymal sac when the obstruction is due to thickening of the mucous folds. The temporary stricture is often relieved by it without the necessity of operative interference.

Calendula.—Particularly useful in obstinate cases, when the blennorrhœa continues after the duct has been opened, and the stricture tends to re-form, and should be applied locally, as well as given internally.

Stannum.—Relieves some cases of blennorrhœa of the sac, where there is a profuse, yellowish-white discharge with sharp pain or itching of the inner canthus, particularly at night.

Arsen. iod.—Proves useful in curing obstructions of the duct dependent upon acute inflammation and swelling of the nasal mucous membrane. It may be suitable in those cases of blennorrhœa of the duct accompanied by a dry ulcerated condition of the nostrils.

Hepar sulph.—In inflammatory conditions of the sac with sensitiveness to touch, and free discharge of pus with or without an opened canaliculus.

Mercurius.—The discharge is thin, acrid, and often excoriates the lid margins, or the cheek where the overflow comes in contact with it.

Silicia.—There is a bland, whitish discharge of decomposed mucous and pus from the distended sac after the canaliculus has been opened and probing begun. It may be also indicated in the recurrent inflammatory attacks of old cases of blennorrhœa of the sac.

Many other remedies have been recommended and have undoubtedly been of service in improving the condition, as Arum tr., Aurum mur., Bell., Calc. Cup., Alum., Hydrast., Fluor. ac., Kali iod., Nat. mur., Nux, Sulphur and Zinc. sulph.

CHAPTER IX.

DISEASES OF THE LIDS.

ANATOMY.

The eyelids are movable portions of integument, strengthened towards their free margins by a thin lamina of dense fibrous tissue; externally they are continuous with the cuticle of the forehead and face, internally lined by the conjunctiva which is reflected onto the eyeball. The upper lid is larger and more movable than the lower, the whole of the cornea being covered by it when closed, and it is chiefly by the elevation of the upper lid that the eye is opened, the movement being effected by the levator palpebræ, which arises in conjunction with the four recti muscles at the apex of the orbit, and passes along the roof of the orbit to be inserted by a broad tendon-like expansion into the tarsus of the lid. At the outer and inner angles (canthi) the eyelids are united, the interval between the canthi being termed the fissura palpebrarum, and on its size depends the apparent size of the eye. The edge of each lid is flattened, except at the inner canthus where it becomes somewhat rounded and changed in direction; at this point on each lid is found a conical elevation, the papilla lachrymalis, upon the top of which is found a minute opening, the punctum lachrymalis.

Throughout the whole extent, except at the inner canthus, the lids are applied by the orbicularis muscle directly to the surface of the eyeball.

The skin covering the lids is thin and more delicate than the contiguous cuticle, presenting fine downy hairs, sudoriferous glands, and at its free margin where the cilia present, it joins the conjunctiva lining the inner surface.

Beneath the skin are found the fibres (*h* Fig. 65) of the orbicularis muscle which closes the eyelids, loose connective tissue, and the dense fibrous plates (*f* Fig. 65) which are termed the tarsal cartilages or tarsi, and are continuous with a thin fibrous membrane (*l* Fig. 65) which attaches the lids to the margin of the orbit, the tarso-orbital fascia.

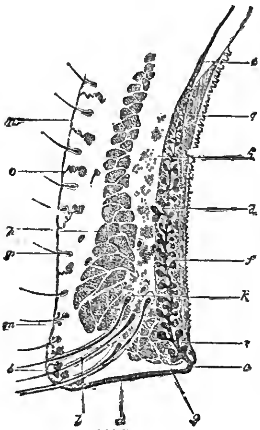


FIG. 65.

The upper tarsus is half oval in form, the lower thinner, narrower, and more round, both giving the shape and firmness to the lids.

On the posterior surface immediately beneath the conjunctiva of the lids, in grooves in the tarsi, are the meibomian glands (*d* Fig. 65), thirty to forty in the upper lid, and twenty to thirty in the lower; they are modified sebaceous glands, which open by minute orifices upon the free margin of the lids, discharging a thin fatty secretion which tends to prevent adhesions of the lids.

The eyelashes or cilia are strong, short, curved hairs arranged in two rows along the margin of the lids at the line of the union of the cuticle and conjunctiva. The upper lashes are more numerous and stronger than the lower and curved in opposite directions; at the inner canthus they are weaker and more scattered. Each cilia drops from its follicle every ninety days and a new one takes its place.

DISEASES OF THE LIDS.

The various tissues which form the lids may be primarily affected by an inflammatory process and tissue change, or they

may become involved secondarily by the inflammation of adjacent parts, as the cuticle of the face, the conjunctiva, eyeball, or orbital bones, and œdema, blepharitis, or abscess follows.

Œdema of the lids is a frequent accompaniment of severe inflammations of the conjunctiva, cornea, or iris and subsides as the exciting conditions improve. It is frequently due to constitutional causes in persons of a feeble or delicate habit who have some heart or kidney affection, and occurs usually during the night. The connective tissue of the lids becomes infiltrated with serum and the skin is distended and pits on pressure. Slight injuries, as the bite of insects, may be the occasion of the swelling. In cases which arise without apparent cause, the internal administration of Arsen., Apis, Rhus tox., or Kali carb., as the general symptoms may decide, is sufficient to relieve the condition, while the swelling is reduced still more rapidly by the application of a compress bandage.

Emphysema of the lids is due to blows or falls, with rupture of the mucous membrane from the contusion. It is frequently an indication of fracture of the nasal bones, or of the ethmoidal or frontal cells. The skin is puffed and gives a crepitant sound on pressure. A compress bandage and rest is all that is required for its relief.

BLEPHARITIS ACUTA.

Acute inflammation of the connective tissue of the eyelids, or abscess, arises from injuries to the lid, or supervenes upon erysipelas of the lids, and occurs frequently in strumous children without apparent cause. The upper lid is more commonly affected. The disease comes on rapidly with great redness, heat and swelling of the lids, and sensitiveness to touch. The swelling is hard, usually at one point, which rapidly increases in size until the lid is enormously distended; soon fluctuation is discernible and the skin thins and becomes yellowish, at some point ulcerates and a large amount of thick creamy pus is discharged, and the swelling and inflammation rapidly subside. Occasionally the abscess may discharge through the

conjunctival surface of the lids. If the abscess forms at the inner angle of the eye it is termed *anchylops;* it may be mistaken for an inflammation of the lachrymal sac, but the absence of a previous history of overflow of the tears will render the diagnosis easy. If the abscess opens through the lid margin of the inner canthus, it is called *œgilops.*

Treatment.—If the case is seen in the beginning, the use of ice-cold compresses and the internal administration of Aconite, Arsen., Apis, Rhus tox., or Pulsatilla according to the following indications will enable us to cause resolution without the formation of pus.

If the case does not come under observation or the remedies do not cause a subsidence of the inflammation, suppuration takes place and hot compresses, or poultices of ground slippery elm bark, together with Hepar sulph., Calc hyp., and Silicia will be required to hasten the formation of pus. As soon as the abscess points, or fluctuation can be determined, the confined pus must have relief by a free incision parallel to the lid border, made with a sharp pointed, narrow, curved bistoury or Beer's cataract knife. Acute blepharitis is likely to leave some deformity from the destruction of the tissue or there may be a general hypertrophied condition of the lid, and a predisposition to attacks of swelling and styes.

Aconite.—In the primary stage with hard, red, swollen condition of the lid, great heat and burning, and sensitiveness to air and touch.

Arsenicum.—Much swelling and œdema of the lids, but with less redness and tension than under Aconite. The pains are burning with profuse, hot and acrid lachrymation, and the general characteristics of Arsenicum as to habit, restlessness and thirst.

Apis mel.—The swelling of the lids is usually similar to Arsenicum but more red and often reddish blue. The pains are stinging and cold applications give relief. There may be extensive chemosis of the conjunctiva and profuse, hot lachrymation, but usually bland. The absence of thirst and the general drowsy condition will differentiate it from Arsenicum.

Rhus tox.—There is early a dusky erythema followed by great swelling of the lids with more or less œdema and tendency to facial erysipelas. Chemosis of the conjunctiva is often present. The pains are not characteristic, but there is relief from warm applications and the general restlessness and aggravation at night.

Calc. hypophos.—Often of benefit in ill-nourished strumous children and has caused resolution without suppuration. The lid symptoms are similar to those of Arsenicum. After suppuration has taken place the destruction of tissue is much lessened by its use.

Hepar sulph. — When suppuration is impending or has already begun. The lids are swollen, hot, with throbbing aching pains and extreme sensitiveness to touch. Hot applications are soothing, which, if allowed to become cool, increase the pains.

Mercurius sol. — Prevents suppuration in some cases when indicated. There is much redness, swelling and thickening of the lid, with great sensitiveness to heat or cold and aggravation at night.

Pulsatilla.—The lids are swollen, red, and thickened, and the acute attack frequently follows a chronic affection of the lid margins or in cases where recurrent attacks of styes have occurred. The pains are described as burning and itching, with evening aggravation and amelioration from cool air.

Silicia.—When the affection arises among persons working in dark, damp or cold places (Calc.) It is more useful after suppuration has been established, hastens repair and prevents extensive loss of tissue. The pains are not characteristic, but there is a sensitiveness of the whole head and relief from warmth; aggravation from cold.

Carbuncle and Malignant Pustule are rarely met with in the eyelids; they present the same features as when occurring upon the other portions of the body and require treatment on general principles. The remedies likely to be required are Ars., Lach., Rhus, and Silic. The diet must be stimulating and every effort made to sustain the patient's strength. The

destruction of tissue is apt to be very great and deformity of the lid results.

ERYSIPELAS OF THE LIDS.

Erysipelas of the lids is usually the accompaniment of a similar facial affection, but the lids may be the starting point, and erythema or hyperæmia of the lids, which presents a bright scarlet color with heat, may or may not be the precursor of erysipelas. It is promptly relieved by Bell. internally. Where erysipelas attacks the lids the swelling is usually soft, with considerable œdema and throbbing pain. Several abscesses may form and the destruction of the lids be consequently great. Complications destructive to vision are apt to occur from extension of the inflammation to the orbital tissue; sloughing of the cornea may result, or the inflammation extend along the optic nerve to the brain causing meningitis and optic neuritis. Bell., Rhus, Apis, Ars., and Verat. virid., according to the indications already given, with a generous diet, will usually control the affection and prevent disastrous consequences.

HORDEOLUM.

Hordeolum or stye (Plate I, Fig. 1) is a furunculous inflammation of one or more of the sebaceous follicles at the roots of the cilia; from the dense character of the connective tissue of the outer edge of the lid and the constant motion of the parts, the swelling which follows is accompanied by an unusual amount of pain. The swelling and œdema may be sufficient to close the lids completely. A yellowish point soon appears and if pricked with a needle or opened with a knife a drop or two of pus escapes and the parts rapidly return to their normal condition. One stye is apt to be followed by others or successive groups appear. The affection occurs in persons suffering from some gastric, intestinal or uterine derangement, and is frequently associated with chronic blepharitis or conjunctivitis due to refractive troubles. In the inception of the trouble the eyelash which appears to be

PLATE I

1

Hordeolum

2

Chalazion

3

Blepharoadenitis

4

Ectropium

5

Symblepharon.

involved should be extracted, and applications of ice to the inflamed part, together with the internal administration of Pulsatilla may abort it. If suppuration has commenced, as is usually the case when they appear for treatment, warm poultices of the pulverized slippery elm bark, or compresses wet in hot chamomile tea will hasten the pointing of the abscess. The general health of the patient demands attention, to prevent the recurrence of the trouble and the removal of the cause. Calc. sulph., Puls., Staph., Graph., Sulph., or Thuya as indicated, administered internally, may prevent the recurrence of the trouble.

CHALAZION.

A chalazion, or meibomian cyst (Plate I, Fig. 2), is a small tumor of the lid arising from the distention of one of the follicles of the meibomian glands imbedded in the tarsus, and is usually symptomatic of a low condition of the system. As it increases in size it forms a little hemispherical swelling beneath the skin, which after weeks or months attains the size of a pea or bean. The skin is freely movable over it and on everting the lids the tissues are found thin toward the conjunctiva and present a bluish appearance. These tumors remain stationary, or grow slowly, and then become inflamed and suppurate at times without apparent cause, and may discharge or shrink up. In other cases the tissue becomes so thin from the growth of the tumor that the conjunctiva covering it ruptures, and a soft pinkish mass extrudes, causing some irritation as it passes over the eyeball. Patients apply for relief from the deformity and not from any annoyance from the enlargement. Occasionally the internal and external use of Thuya, Merc. iod. flav., or Staph., may cause their disappearance, but the most rapid method of treatment is by a crucial incision

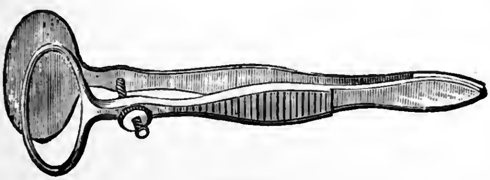


FIG. 66.

through the conjunctival surface over the growth, on the eversion of the lid, never through the skin, and the contents of the cyst which are cheesy, gelatinous, or creamy, removed by a scoop made for the purpose. If large, portions of the cyst wall should be removed by the forceps and a minute point of nitrate of silver introduced; care should be exercised to prevent the caustic from coming in contact with the conjunctiva. Clamp forceps, as in Figs. 66 and 67, to inclose the tumor and by compression of the lid prevent bleeding which becomes very annoying, have been devised by Desmarres, Snellen, Knapp and Prout and while materially assisting the operation

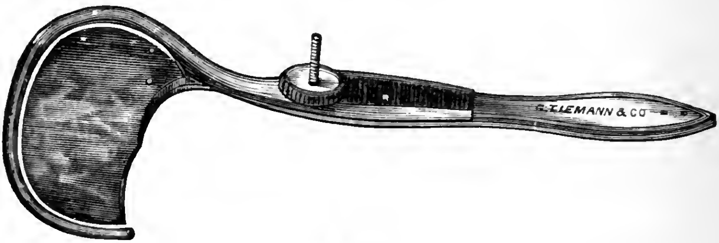


FIG. 67.

are not absolutely necessary. The patient should be directed to apply cold applications for a few hours after the operation if there is any painful reaction after it. The deformity does not disappear immediately, as the cavity left after the removal of the tumor fills with blood which is not absorbed for twenty-four hours, and the rough edges of the wound may cause some discomfort from rubbing against the cornea, but this usually disappears in a few hours if the eye is kept quiet. General tonic measures, together with the correction of any conjunctival trouble and the avoidance of over use of the eyes are indicated, and Staph., Thuya, Calc. iod., to prevent their recurrence are useful.

BLEPHARO-ADENITIS.

Blepharo-adenitis (Plate I, Fig. 3), blepharitis marginalis, tinea tarsi, ophthalmia tarsi and acne ciliaris, are all synonymous terms applied to the chronic inflammation of the free

edge of the lids, leading to the formation of small pustules, superficial ulcers and excoriations.

Symptoms.—In the early stages of the disease the patient complains of weak eyes, that they are glued together in the morning, and that there is much itching after prolonged use of the eyes; the edges of the lids look red and raw. The affection usually begins with the appearance of a few hard crusts at different portions of the lid edge among the cilia, gluing several of them together. These are difficult to remove, but when detached, small reddish spots, or superficial ulcers are revealed. Sometimes the lashes have small collections of pus around them. As the disease advances, the inflammation involves all the follicles of the cilia, the edges of the lids become much thickened and rounded, and the puncta closed, giving the blear-eyed expression so characteristic of the advanced stages of this affection. A chronic conjunctivitis is oftentimes produced, the lashes drop off, and the new ones are destroyed, or not well formed, owing to the destruction of their bulbs, and the lids may finally become entirely destitute of lashes, presenting the condition known as *madarosis* or bald lids. If not checked by treatment the cellular tissue of the lid becomes affected and contracting draws the free edge away from the ball, the puncta become everted, and the tears accumulating cause additional irritation.

Causes.—It is a frequent accompaniment of diseases of the lachrymal ducts, and arises from the excoriation due to the overflow of tears and requires relief of the obstruction when it exists before improvement can be made in the condition of the lid.

The disease is most common among ill-nourished children of strumous habit with blonde complexions, and is frequently a sequel of measles or scarlet fever. Conjunctivitis, particularly of a granular form, as well as refractive errors and muscular weakness are a frequent accompaniment.

In some cases the presence of lice, *phthiriasis ciliarum*, in the eyelashes may be mistaken for blepharitis mar-

ginalis or may be the exciting cause of the inflammation. The examination with an object-lens will show signs of life at the root of the lashes and nits may be found grafted along the stems of the cilia. The larger ones can be picked off with a pair of fine forceps, or the lids may be bathed in warm water and Staphisagria tincture applied along the roots of the lashes with a camel's hair brush. If this fails a small portion of blue ointment carefully applied to the lid margins will effect a cure.

TREATMENT.—The disease is often exceedingly obstinate and may last for years, if neglected. When arising from refractive errors, proper glasses must be prescribed and worn. If accompanying a chronic conjunctivitis, attention must be directed to its relief, as it is almost impossible to cure the glandular inflammation while this exists. If the punctum is everted, it is well to slit the canaliculus, and if there is much thickening of the conjunctiva a mild collyrium of borax gr. viii to f℥j is of frequent service. General treatment is necessary in the majority of cases, the diet should be nutritious, the patient warmly clothed, and above all cleanliness insisted upon. The crusts must be removed every morning by the patient or attendants, after softening them in warm water. This is more readily done after the application of glycerine or some oily substance to the lids the night before. During the day the accumulation on the lashes should be removed as soon as formed, and if the crusts are hard, they should be softened by bathing with a warm alkaline solution of sodæ bicarb. gr. xx to ℥j; borax solution gr. x to ℥j; or tar water, for ten or fifteen minutes and then thoroughly removed; after they are removed, some mild vaseline ointment may be rubbed among the roots of the lashes, when the lids are closed. This will materially relieve the irritation arising from the formation of the crusts and at the same time hasten the cure. The ointments most commonly in use for this purpose are grapho-cosmoline, yellow oxide of mercury, the white precipitate, or the red oxide, gr. ii ad ʒij of vaseline. Where there is a tendency to recurrence pulling out the eyelashes as they loosen often proves of bene-

fit; where the entire lids are involved, and red and painful, slippery elm poultices at night afford much relief.

If the disease has advanced to that stage where the eyelashes have been destroyed and the lid margins rounded off and reddened, relief from the exciting cause, and proper medication will lessen the deformity, but will not re-produce the cilia.

Aconite.—Indicated in an acute attack, but such cases are extremely rare, and when occurring, result from exposure of the eyes to dry cold winds during long drives. The lid margins are swollen, hot and dry, and there is more or less inflammation of the conjunctiva accompanying it.

Graphites.—The action upon the edges of the lid is very marked, and is perhaps the most useful remedy we possess for the chronic form of blepharitis, particularly when occurring in strumous subjects and accompanied by the moist, fissured and easily bleeding, eczematous eruptions on the cheeks or behind the ears, which are so promptly cured by this remedy. The swelling of the margins of the lids is variable, in color pale red, and crusted with dry scabs which cover spots of ulceration, or numerous fine scales are found on the skin and among the cilia which can be brushed off. There is much itching, burning and biting of the lids which the patient tries to relieve by rubbing, but this only aggravates the trouble. In many cases there is a fissured condition of the skin of the outer canthus, which bleeds readily from rubbing or opening the eyelids. The cure is hastened by the application of the graphites ointment to the lids at night.

Mercurius.—The various forms of mercury are extremely useful in blepharitis, the Merc. sol. or vivus more frequently perhaps than the others. The lids are much thickened, red, and often ulcerated, with sensitiveness to touch, heat and cold. The lid conjunctiva is hyperæmic, or inflamed, with an acrid lachrymation which increases the irritation of the lids. There is an aggravation of the whole condition from exposure to the light and heat of fires, or in the evening from artificial light. The local application of an ointment containing grs. ii of the

merc. precip. alb, or the merc. iod. flav. to ℥ij of vaseline will be found very useful.

Merc. cor. and prot. present similar symptoms, but in a more marked degree and where there is a pustular eruption on the parts about the eye or upon the conjunctiva.

The prescription must be based upon a careful consideration of the circumstances and symptoms as well.

Sulphur.—Suitable in a large number of cases occurring in scrofulous children where the disease is occasioned by the debility following the exanthematous diseases, or appears as the accompaniment of eczema of the face or head for which Sulphur would be indicated. The lids are red, swollen, with numerous small points of suppuration, or are ulcerated along the edges. The characteristic pains are fine, sharp and sticking, though itching, biting, burning and many other sensations may be present. There is usually an aggravation from wet applications to the parts as well as a general aversion to being washed.

Pulsatilla.—In cases arising from some gastric derangement dependent upon high living with consumption of fat foods. There is a great tendency to the formation of styes, and frequently acne of the face. The swelling and redness of the lids may vary, though there is usually a rather profuse, bland discharge which agglutinates the lids during the night. Itching and burning are complained of, with a general evening aggravation and from a close or warm atmosphere, with relief from fresh cool air.

Arsenicum.—Blepharitis occurring in cases where the general condition presents the debility, restlessness, thirst, night aggravation, etc., of Ars. The lids are often puffed and their edges very red, and excoriated by the acrid lachrymation which is a frequent accompaniment of the condition—again the lids may be smooth, red, and shed numerous scales. The pains are burning in character.

Calc. carb.—Especially adapted to blepharitis in fat, unhealthy children who sweat much about the head. The lids are swollen, œdematous and red, with a thick, excoriating,

purulent discharge, accompanied by great itching and burning of the lid margins, particularly at the canthi, with aggravation from damp weather and in the morning.

Calc. phos. and iod. are serviceable in strumous cases presenting enlargement of the tonsils and cervical glands, with the eye symptoms of the *carbonate.*

Hepar sulph.—The lid margins are studded with small ulcers which destroy the lid tissue; or they are thick, inflamed and tender to the touch, with small furunculous swellings along the margins or in the meibomian glands; eczematous condition of the face or outer canthus of the lid with cracking and bleeding on opening the eyes (see Graph.).

Petroleum.—Indicated in affections of the lid when there is itching and dryness, with smarting and sticking pains in inner canthus. The skin of the lid is often rough and dry, and frequently accompanied by the occipital headache characteristic of Petroleum. The external application of vaseline or cosmoline softens the skin and prevents the rapid formation of the crusts and the gluing together of the lids, and thus by giving relief from this annoyance exerts a beneficial influence.

Nux vom.—Cases occurring in adults where there is much smarting and burning with aggravation in the evening, and when complicated with gastric derangement which is often due to constant indulgence in stimulants.

Antim. crud.—Curative in cases occurring in children where Graphites seems indicated, but when administered gives no result. The lids are inflamed, swollen, moist, and there is a pustulous eruption upon the lids or upon the face, with frequent agglutination and photophobia in the morning.

Natrum mur.—Useful where the lids are inflamed and thickened, accompanied by smarting and burning, with some conjunctival inflammation and a sensation of sand in the eyes. The lachrymation is acrid and excoriates the lids and cheek, giving them the characteristic glossy appearance.

Rhus tox.—Suitable in some cases where there is heaviness and stiffness of the lids, or an œdematous condition with profuse lachrymation.

Sepia.—Scaly conditions of the lids, or small points of pustular inflammation at the roots of the cilia, with a sensation as if the lids pressed too hard on the eyeball.

Staphisagria.—Lids with dry, uneven margins or hard nodules, and much itching and sensation of dryness of the eyes in the morning.

Argentum nit., Euphras., Antim. tart. and Merc. nit. may be indicated in cases dependent upon, or associated with, conjunctival disease; other medicines may relieve when indicated by the general symptoms of the remedy without special reference to the eye symptoms.

TRICHIASIS.

Trichiasis or inversion of one or more of the eyelashes, is a frequent result of chronic and neglected inflammation of the conjunctiva and lid margins. The incurved cilia, if allowed to remain, give rise to a persistent conjunctivitis, haziness or vascularity of the cornea.

The separation of the double row of lashes, with the inversion of one of them, *distichiasis*, occurs occasionally as a congenital condition, and the inner row under these circumstances is inverted and is constantly rubbing the cornea and conjunctiva.

Treatment.—The treatment is purely surgical and depends upon the extent of the disease. If only a few of the cilia are directed against the eyeball they should be seized, one by one, by a pair of cilia forceps (Fig. 68), and extracted. To do this properly and carefully, and with the least pain to the patient, requires skillful manipulation. To extract the cilia properly, the patient should be seated, and, the surgeon standing behind, gentle pressure upon the lid with the thumb or finger is made while a pair of forceps with broad ends and smooth surfaces, which meet perfectly for at least an eighth of an inch, are used. The forceps are passed over the lash to the skin, compressed, and the lash extracted by a firm but quick pull. If the lash is not seized near the root, it is apt to be broken off. If the lashes are light in color and ill

formed, difficulty is often experienced in determining their position, but if the patient is directed to rotate the eyeball in such a manner as to bring the pupil behind the lash a dark background is formed on which the offending object is easily distinguished and may be seized with the forceps and extracted. The lashes thus removed will grow again, but the removal of the associated disease, whether it be a conjunctivitis or lid affection, with the constant epilation, will finally result, in many cases, in their destruction. If only one or two lashes turn in, their direction

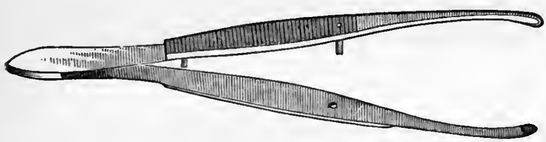


FIG. 68.

may often be improved by a little operation revived by Snellen, called *reposito ciliarum.* Both ends of a fine silk thread are brought through the eye of a delicate needle which is carried through the free edge of the lid just outside of the root of the misplaced eyelash and brought out on the skin at 1 or 2 mm. from the border. The looped end of the thread is carefully placed around the cilia, which is then dragged through the puncture made by the needle. It is by no means permanently successful, but is frequently performed, and occasions no deformity. Knapp suggests that the lash itself be threaded in the eye of the needle and drawn into position.

A plan has been recommended to get rid of a group of several lashes by means of a silk ligature introduced so as to include them and then tightly tied. Much pain and inflammation follow the operation and the result is unsatisfactory when the whole or a portion of the lashes are involved. The radical cure of the trouble consists in the cutting out of the follicles of the lashes at the border of the lid or transplanting the ciliary portion further up on the lid. It may be effected in the following manner: A horn spatula, made for the purpose (Fig. 69), is passed under the lid to render it tense and to protect the eyeball. The lid is split by an incision made about one-fourth of an inch deep along the edge of the lid

parallel to and within the roots of the cilia. A second incision is next made through the skin in a plane at right angles to the former along the whole length of the lid, or that portion where the distorted cilia are imbedded, so that a strip of skin is removed containing the roots of the lashes. The re-

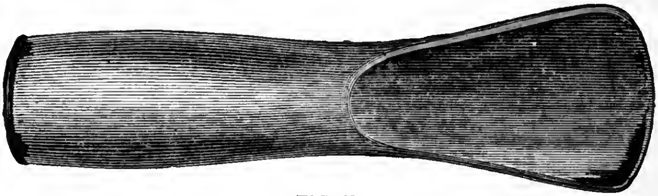


FIG. 69.

action is slight and requires only a cold water dressing. When only a small portion of the eyelashes are at fault they may be extracted, and the endeavor made to destroy the bulbs by the introduction of hot needles into the follicles while the lid is held in a clamp. Transplantation of the outer portion of the lid containing the ciliary row may be useful. (Fig. 70).

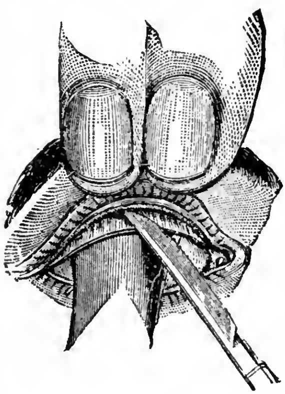


FIG. 70.

The operation is made in the following manner: the patient is etherized and the lid held tense on a horn spatula beneath, so as to protect the eyeball, when a thin narrow scalpel is introduced into the border of the lid in a line between the mouths of the meibomian ducts and the lashes, and the lid split throughout its entire length to the depth of one-fourth or one-third of an inch, so that the portion containing the cilia is movable upon the surface from which it has been separated. An elliptical strip of skin one-fourth to one-half an inch wide with the underlying muscular fibre is now dissected out of the middle of the lid, and the edges brought together with sutures; the part at the border of the lid exposed by the transplantation of the ciliary portion is left to heal by granulation. If the tissues are not carefully handled, or the

dissection made too freely, there is danger of sloughing, which, while it may relieve the trichiasis, does not improve the appearance of the patient. A light bandage should be applied after the operation and if there is but slight reaction, the parts heal by first intention and the sutures are removed after forty-eight to seventy-two hours.

ENTROPIUM.

Inversion of the margins of the eyelids against the eyeball may be partial or complete. (Fig. 71). A partial entropium with trichiasis may be due to permanent contraction of the fibres of the orbicularis which lie close to the free border of the lid, a result which follows in long-continued cases of photophobia.

FIG. 71.

SPASMODIC ENTROPIUM.—A form of entropium (Fig. 72) due to spasm of the orbicularis, termed senile entropium, occurs in old people with lax and wrinkled skin, and is sometimes seen after bandaging the eyes after cataract operation. The lower lid is generally affected and the ciliary margin is rolled in upon itself so as to be invisible unless the skin of the lid is retracted, when it assumes its normal position to return soon after the traction is relieved; the fibres of the orbicularis, near the edge of the lid, contract and turn the cilia inward again, and thus the cornea and conjunctiva become irritated from the constant rubbing of the lashes, and serious changes occur.

FIG. 72.

Treatment.—If the condition has arisen from bandaging, the removal of the cause and the application of collodion

painted on the lid, or strips of plaster, may retain it for a sufficient length of time in its normal position to allow the fibres of the orbicularis to recover from the spasmodic condition. In other cases much benefit is derived from the patient's constant attention to the lid at frequent intervals of the day. He should be directed to draw upon the skin of the lids sufficiently to bring the cilia into proper position as often as possible. In other cases the excision of an elliptical portion of the skin of the lid may be sufficient to relieve the condition.

Causes.—Entropium is commonly caused from the contraction of the conjunctiva after trachoma or granular conjunctivitis. The cicatrices formed in the conjunctival tissue as the effect of the trachoma, contract and increase the curvature of the tarsus to such an extent that the ciliary margin of the affected lid is turned inward. Together with this condition, the lashes are irregular and distorted, and constantly rubbing against the cornea they destroy its transparency and occasion much irritation. In these cases the lids present so much structural change that it is impossible to restore the cilia to their normal position by the retraction of the skin of the lid.

Treatment.—The treatment consists either in removing the cilia together with their bulbs, so as to relieve the irritation of the cornea, or the performance of an operation for the relief of the entropium. Hotz's operation for trichiasis and entropium is an admirable one for the cure of many of these cases, and consists essentially of a transverse incision of the lid along the upper or lower border of the tarsus according as the operation is made upon the superior or inferior lid, the excision of a portion of the muscular layer 3 to 4 mm. in width and the insertion of deep sutures through the tarsal border and the tarso-orbital fascia. The operation is performed in the following manner: the skin of the brow is fixed by the pressure of the finger of an assistant at that point. The ciliary margin of the lid is seized at the centre between the thumb and forefinger, or with a pair of forceps if the cilia are short, and drawn downward so that the curved furrow in the skin of the

lid, which begins about 2 mm. above the inner canthus and marks the upper border of the tarsus, becomes a straight horizontal line. A transverse incision is now made through the integument and muscles to the aponeurosis of the tarsus, care being exercised to prevent an incision of the tarso-orbital fascia. A strip of the muscular layer of the orbicularis from 3 to 4 mm. in width and the length of the wound is excised, the dissection being thoroughly done, so as to leave no muscular fibres on the upper border of the tarsus. After all hemorrhage has ceased, the sutures are to be introduced in the manner shown in Fig. 73, being passed through the integument of the lower edge of the wound as at *f* in Fig. 74 and thence through the aponeurosis *a b* and brought out and passed through the integument at *d*. After seeing that no muscular fibres are included between the sutures, they are tightened. Four or five sutures are required and the success of the operation is dependent upon the insertion of the sutures into the true upper border of the tarsus. If the tarsus is thickened and contracted, Streatfield's operation for grooving the cartilage is advantageously combined with the operation. After the operation is completed, cold compresses are applied and the stitches removed on the third or fourth day.

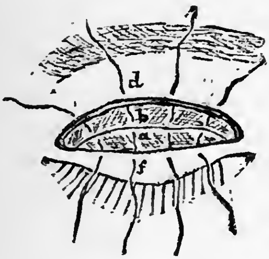


FIG. 73.

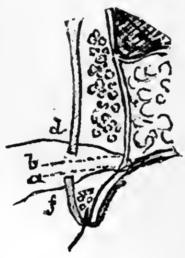


FIG. 74.

CANTHOPLASTY.

Entropium is frequently associated with or caused by shrinking of the tarsus from side to side, and the palpebral fissure becomes shortened In other cases the pressure of the thickened lid upon the eyeball is such as to injure its integrity. For the enlargement of the palpebral fissure the operations of canthotomy or canthoplasty are made. The former is intended

simply for temporary relief and is accomplished by dividing the outer canthus horizontally in the line of the raphe with a pair of scissors or with a scalpel. The canthoplastic operation (Fig. 75) is rather more extensive. A curved bistoury is introduced into the conjunctival sac at the outer canthus, pushed horizontally outward to the edge of the orbit in a line with the commissure of the lids, and made to cut its way out through the conjunctiva, skin and intervening tissues. The skin and conjunctiva are then united by three sutures, one at the outer angle, and the other two midway on each lip of the wound.

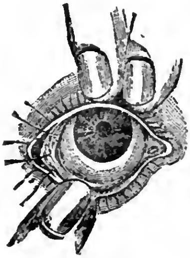


FIG. 75.

When the conjunctiva is much atrophied and the palpebral fissure much contracted a still more extensive operation is demanded. That devised by Noyes will be beneficial; this consists in the formation of a flap from the skin of the temple, which is turned down and placed in the external canthus, and secured with sutures.

ECTROPIUM.

Ectropium or eversion of the lids (Plate I, Fig. 4) (Fig. 76), is more serious than entropium, as the conjunctiva is exposed and becomes thickened with exuberant granulations or dries up. The tears run over, and the eyeball being exposed to irritation soon suffers. The eversion may take place in either lid, though the lower is more generally affected.

FIG. 76.

CAUSES.—The causes which occasion it are chronic thickening of the conjunctiva following purulent or granular inflammations, blepharitis marginalis, paralysis of the seventh nerve, contraction of the skin from burns, wounds, cancerous growths, or caries of the bones of the orbital margin.

TREATMENT.—Operations for the relief of ectropium are numerous and individual cases require modifications of them, or additional operations to suit the peculiar existing conditions. Wharton Jones' operation (Fig. 77) answers very well in cases where the deformity is not very great. It may be made upon either the upper or lower lid, but suits the latter best. For the operation a horn spatula is introduced into the conjunctival sac, and a triangular flap is made with the base towards the ciliary margin, sufficiently great to allow the lid to return to its place. The flap is then dissected up, care being taken not to go too deep or involve the conjunctiva. The lines of the incision are then brought together with sutures as in Fig. 78. When it is necessary to shorten the lid, it may be combined with tarsoraphy. When it is desirable to shorten the lid without tarsoraphy the operation of Adams, see Figs. 79-80, may be employed. As there is no elevation of the lid from the operation, it should be performed at the outer canthus. Here a V-shaped incision is made through the conjunctiva and thickness of the lid, the included portion removed, and the edges of the wound accurately approximated with sutures as in Fig. 80. In severe cases, Diffenbach's operation which also shortens the lid may be found expedient, particularly when the ectropium is

FIG. 77.

FIG. 78.

FIG. 79.

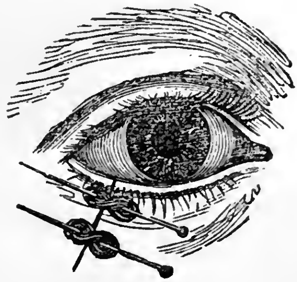


FIG. 80.

dependent upon a contracting cicatrix. The latter is first dissected away, as in Fig. 81, so as to leave a triangular wound with the base towards the lid margin and the tarsus preserved if possible. If not, the conjunctiva is carefully dissected off and laid upon the eyeball while a rectangular incision (Fig. 82) is made through the sound skin at the outer or inner canthus as deemed best; the inclosed flap is then dissected from the subcutaneous tissue and slid into position and secured by fine sutures. The flap should be larger than that apparently needed to fill the gap, while the surface left by the transplanted flap is to be filled with small skin grafts. A water compress, or a light retaining bandage is to be applied, or if sloughing of a portion of the flap takes place the temperature of the part must be improved by frequent applications of warm water.

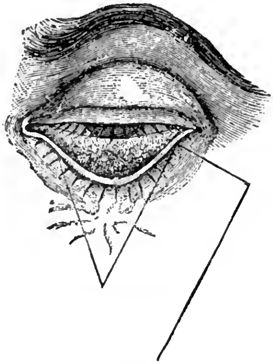


FIG. 81.

FIG. 82.

Von Graefe's operation is indicated in cases of elongation of the lid resulting from blepharoadenitis, but space does not admit of further description.

TARSORAPHY.

As canthoplasty was advocated in entropium, the converse operation should be performed in ectropium. In the performance of this operation, the edges of the lid, as far as may be considered necessary, are freshened by removing the skin from the cilia to the inner edge, as in Fig. 83,

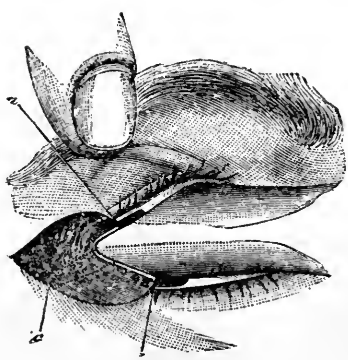


FIG. 83.

sparing as much as possible the openings of the meibomian glands, and freshening the commissural folds. Two to four fine silver sutures, as in Fig. 84, are passed through the whole border of the lids, the freshened parts are brought accurately together and a pressure bandage insures union. This operation may also be used when the palpebral fissure is too large from any cause.

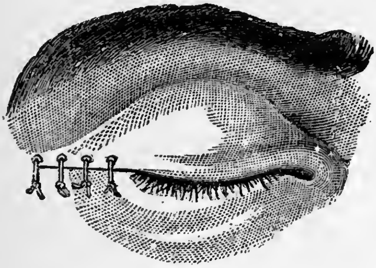


FIG. 84.

BLEPHAROPLASTY.

If, as a consequence of wounds, ulcerations, or cancerous growths, the eyelids have become more or less destroyed, they may be restored in many cases by plastic operations. For this purpose the operation of Diffenbach may be used. When only part of the lid has been removed, a similar operation proposed by Arlt is useful. After removing the portion *a*, *b*, *c*, Fig. 85, by a slightly curved incision the flap *e*, *d*, *f*, is made. The angle *e*, is united to the angle *a*. The internal palpebral ligament affords sufficient support to prevent the sliding of the flap downward which is maintained by horizontal sutures. The end *d*, of the flap is united by one or two sutures to *c*; the edge of the flap *d*, *f*, forms the inner border of a triangular space left by the sliding of the flap which is to be filled by grafting.

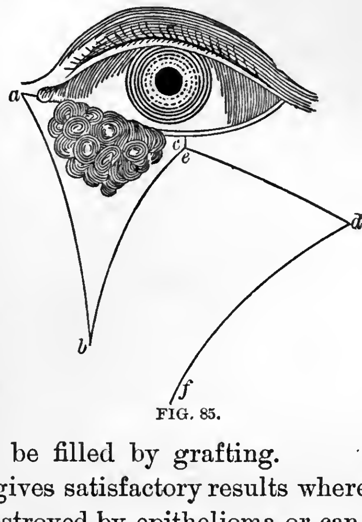


FIG. 85.

Knapp's operation (Fig. 86) gives satisfactory results where a portion of the lid has been destroyed by epithelioma or cancerous growths. After complete dissection of the growth, the

incisions are made as indicated in the cut, and the flaps loosened and stretched to cover the wound and united by sutures. The operation of tarsoraphy combined with skin

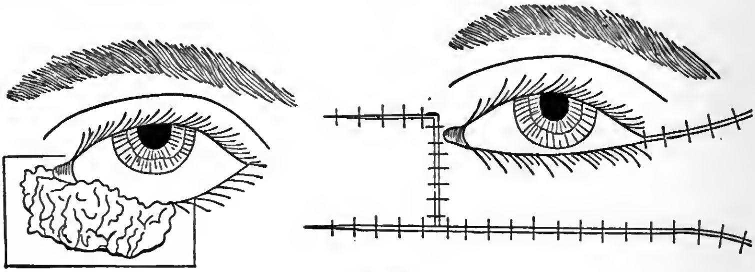


FIG. 86.

grafting may enable us to dispense, in some cases, with an operation for blepharoplasty.

PTOSIS.

Drooping of the upper lid may be complete or incomplete, and is due to paralysis of the third nerve, to deficient power of the levator, or to increased weight of the lid from hypertrophy of its tissues. The power of the levator is in direct ratio to the normal weight of the lid, and those conditions which increase its weight, as blepharitis, granular conjunctivitis, œdema, erysipelas, abscess, tumors, deposits of fat, or prolonged bandaging, disturb the natural balance, and the levator is no longer able to raise the lid as before. It is necessary to distinguish between the condition arising from paralysis and that from a thickening of the lid. This may be readily accomplished by pinching up a fold of the lid between the thumb and finger, when, relieved of the extra weight, the levator will act if the ptosis is due to the latter condition. If the lid, under these conditions, remains immovable the trouble is due to paralysis. When the ptosis arises from an affection of the third nerve, the other muscles supplied by the nerve will generally participate, and when the lid is raised the eyeball will be turned outward and diplopia be produced. When the levator only is deficient, the defect may be congenital; reflex, from injury of the fifth

nerve; or the result of injury, and on raising the lid the eyeball and vision appear normal.

Treatment.—The cause must be determined and removed. If due to diseased conditions of the lid these must be relieved by appropriate treatment, when the ptosis will disappear. The temporary loss of power following œdema, or inflammation of the lids, is recovered as the parts regain their normal state, and hence requires no special treatment. When dependent upon paretic or paralytic affections of the levator, the internal use of such remedies as Caust., Gels., Rhus, or Spig., together with the faradic or interrupted galvanic current, will prove useful in many cases.

No operation for the relief of the ptosis should be undertaken until three or four months have elapsed, and other treatment has proved unavailing. If paralysis of the internal rectus is associated with the ptosis and no relief has been gained from remedial treatment, it is not expedient to make an operation for the relief of the drooping lid, as the retraction of the lid would increase the patient's discomfort by causing the diplopia to become permanent.

PARALYSIS OF THE ORBICULARIS.

Loss of power of the orbicularis may be due to lesion of the seventh nerve and is one of the symptoms of facial paralysis. The eye cannot be closed by the action of the orbicularis and remains open, producing the condition termed *Lagophthalmos*. This condition may also arise from atrophy of the muscular fibres of the orbicularis. There is more or less drooping of the lower lid, and overflow of tears from the eversion of the punctum, and when the condition is only a paresis, the overflow of tears may be the only symptom of the affection of the orbicularis.

Causes.—The cause of the lesion may be central or peripheral. Of the latter, exposure to drafts, colds and injuries of the face are common; of the central causes, syphilis and middle ear diseases are the most frequent. If the auditory

nerve is also affected, the lesion may be located in the temporal bone where the two nerves are in close apposition. The danger to the eye in these cases is from exposure of the cornea which may become ulcerated.

TREATMENT.—To prevent danger to the cornea plaster strips may be used to close the eye. At night closure of the lids with the pressure of the fingers will be sufficient to retain them in their position during sleep. The faradic current with the negative to the neck and the positive to the muscle for ten minutes daily may be sufficient. The internal administration of Caust., Bell., Nux or Zinc., may be beneficial in some cases.

BLEPHAROSPASM.

Spasm of the orbicularis is usually reflex from some corneal or conjunctival irritation and inflammation. It may be either clonic or tonic.

NICTITATION, or frequent winking, is a clonic variety of blepharospasm and consists of simple twitching or winking which is confined to the eyelids, and may be congenital or result from some hyperæmic or granular condition of the conjunctiva, refractive error, or from a diseased tooth. The cause as far as possible must be removed, the general tone improved, and when idiopathic it will oftentimes be relieved by the use of Agar., Physostig., Ignat. and Hyosc.

BLEPHAROSPASM is tonic in character and longer in duration than the other variety. It arises more frequently from irritation of the retina or branches of the fifth nerve of the cornea, conjunctiva, or iris by light and accompanied by photophobia and is a frequent accompaniment of inflammatory affections of the eye in scrofulous or debilitated subjects, but may be due to extraneous causes, as exposure, or the presence of foreign bodies in the cornea or conjunctiva.

TREATMENT.—When idiopathic or chronic, Agaric., Gels., and Conium will relieve some cases. If the refraction is found anomalous, proper glasses are to be worn. Division of the supra-orbital nerve may be indicated in other cases, where there is sensitiveness at the exit of the nerve.

I have relieved some cases, occurring in strumous children with conjunctival or corneal affections, by the use of ice bags applied to the eyes for one or two hours per day. The topical application of ice-water has also been recommended to relieve the spasm. Division of the outer canthus may become necessary in some cases.

ECZEMA frequently accompanies phlyctenular affections of the cornea or conjunctiva in children, or may be associated with an eczematous eruption of the face or behind the ears, and requires the use of Graph., Hepar sulph., Ars., Crot. tig., Antim. crud., Mez., Sepia, Lycop. and Tell., according to the indications necessary for similar eczemas of other parts.

HERPES ZOSTER is an affection of the nervous apparatus depending upon irritation of the Gasserian ganglion or sensory root of the fifth nerve. There is severe neuralgic pain involving one side of the forehead, eyelids, eye, and perhaps the face. The skin becomes swollen and red, with herpetic vesicles upon the surface. These soon form hard crusts which leave depressed, red scars. The eruption may not be confined to the eyelids but appears upon the conjunctiva or cornea, where it becomes exceedingly dangerous, and other complications of the eyes occur. It may appear at any age but more frequently in the latter years of life. It is very protracted in its course and months may elapse before the disease disappears.

TREATMENT consists in the relief of the pain, which is frequently the most urgent symptom, by the use of narcotics. Graph., Arg. nit., and Ars. may be the remedies indicated in the case. In two cases which have been noted by the writer, one was relieved by the use of Arg. nit., and the other by Ars. In both cases severe scars were left and but slight destruction of the tissues of the lid occurred.

SYPHILITIC ULCERS of the lid do not differ in appearance from those occurring in other parts of the body, but are frequently destructive to large portions of the lid.

LUPUS of the lid may occur as a primary affection or extend from the face. It may continue for years, healing at times, to

again re-open, and there is usually a dark crust which covers the ulceration, and, when removed, exposes a raw, bleeding surface. Phytolacca internally and externally has undoubtedly relieved some cases of lupoid growth, but incision is advised when the disease is not too extensive.

EPITHELIOMA is usually more rapid in its destructive process than lupus and may ulcerate, and infiltration of the lymphatics in front of the ear frequently exists in the latter stages of the disease. Complete excision is the proper remedy, and a blepharoplastic operation should follow.

XANTHELASMA is an affection of the lids in which yellow, slightly raised patches appear near the inner canthus, which consist of a deposit of fat cells in the skin, and are supposed to be dependent upon some disease of the liver. The deformity may be relieved by an operation for the removal of the patches, but this is rarely acceded to by the patient.

NÆVI, WARTS AND MOLES of the lids do not differ from the same affections in other parts of the body, but from the important structures involved require early removal.

MOLLUSCA are small, round tumors of varying size which are developed in the follicles of the skin of the lid and face. A slight dimple on the top of the tumor indicates the opening of the follicle through which a milky fluid often extrudes which is supposed to be capable of reproducing the disease. The tumor should be opened and the albuminous contents squeezed out. The internal and external use of Thuya produced marked benefit in one case observed by the author.

COLOBOMA of the lid is a congenital fissure of the same character as hare-lip. It is treated by paring the edges of the lid and uniting them with a deep suture.

EPICANTHUS is a term applied to a crescentic fold of skin which slightly overlaps the inner canthus of each eye. It is congenital and usually decreases as the child grows and the bridge of the nose develops. In extreme cases an improvement may be obtained by the removing of a vertical ellipse of skin from the bridge of the nose and uniting the edges of the wound by sutures.

Anchyloblepharon is a condition in which the lids are adherent to each other, and may be total or partial. It may be congenital or caused by ulcerative blepharitis marginalis, or result from burns when the cornea or conjunctiva is also involved. An incision may be made along the line of union and the separated surfaces smeared with cosmoline or painted with collodion to prevent their adherence.

Tumors of the lid, other than those already considered, require incision, and in operating as little skin should be sacrificed as possible, so as to have sufficient cuticle to cover the parts without stretching.

Injuries of the lid have already been considered in the chapter devoted to Injuries of the Eye.

CHAPTER X.

DISEASES OF THE CONJUNCTIVA.

ANATOMY.

The conjunctiva is the mucous membrane lining the lids; it is continuous with the integument at their margins and also with the mucous membrane lining the puncta, canaliculi, lachrymal sac and duct, and is reflected back upon the eyeball, covering the sclera and extending slightly upon the edge of the cornea. It consists of two portions: the palpebral, with which may be included the plica semilunaris and caruncula, and the ocular, or *conjunctiva bulbi*, in which may be distinguished the sclerotic and corneal portions; each of these parts present distinctive characteristics. The epithelium of the conjunctiva varies somewhat at different points, but is mainly columnar, with small cells between their fixed ends; near the skin and cornea it shades off into the stratified epithelium which covers these parts. At the point where the conjunctiva is reflected from the lids upon the eyeball it forms a fold, which is termed a cul-de-sac, fornix, or retro-tarsal fold, or when applied to the upper or lower lid, the superior and inferior palpebral fold. At the inner canthus, we find a small rounded eminence termed the *caruncle* which consists of small glandular bodies containing numerous sebaceous follicles and some fine hairs; toward the cornea are seen small crescentic folds of conjunctiva, the *plica semilunaris*, which are regarded as a rudimentary development of the third eyelid of animals.

The palpebral portion of the conjunctiva is thicker and more vascular than the ocular, and presents a pale salmon color. It is composed of columnar and flat epithelium fixed upon a connective tissue basis. Although closely connected to the tarsi, it, however, presents numerous minute furrows and folds discernible with a magnifying lens, which give to it a velvety appearance. Just beyond the upper border of the tarsus, it is drawn into broad folds at the fornix; in these folds, as well as scattered through the palpebral conjunctiva, are found numerous small conjunctival glands which secrete the moisture and lubricating material which keep the eye moistened, and are of more importance in this respect than the lachrymal gland whose main office seems to be to flood the eye. The retro-tarsal folds are very loosely attached to the parts beneath and are of a darker color than the conjunctiva of the lids.

The ocular conjunctiva is smoothly but loosely attached to the eyeball by submucous tissue. It is transparent and but few blood-vessels are seen in the healthy condition. At the margin of the cornea, the conjunctiva slightly overlaps the cornea while the epithelial layer is continuous with that of the cornea.

The blood-vessels are derived from the palpebral and lachrymal arteries. The nerves are branches of the fifth pair and form a thick plexus from which terminal filaments are very numerous and end among the epithelium. A well-developed network of lymph vessels appears throughout the sclerotic and palpebral portions of the conjunctiva and communicates with those of the cornea.

DISEASES OF THE CONJUNCTIVA.

The term ophthalmia, which was formerly extensively used, is in the present advanced knowledge of ophthalmology applied only to affections of the conjunctiva, and as it describes no particular condition, it should be dropped from the nomenclature of eye diseases.

The conjunctival tissue may be distended by an effusion of blood, ecchymosis; of serum, chemosis; or air, emphysema; or be subject to inflammation, as in the various forms of conjunctivitis.

Ecchymosis is occasioned by the rupture of one or more of the capillaries of the conjunctiva from injury, as during violent coughing, sneezing, or vomiting, or often without any assignable cause. The effused blood appears as a small red patch on the white of the eye, or may be so abundant as to entirely cover the sclera and extend up to the edge of the cornea. The appearance is so entirely different from any inflammatory affection of the conjunctiva that it is not easily mistaken. Whether the extravasation be slight or great it is unimportant, as it is gradually absorbed and dispersed in from one to three weeks. It is unsightly, however, and alarms the patient. The use of Hamamelis and Arnica locally, and the same remedies internally, cause a rapid absorption of the effused blood and is all the treatment that is necessary.

Chemosis or œdema of the conjunctiva, is a symptom which may accompany the various inflammatory affections of the eyeball or its appendages. It consists of an effusion of serum between the conjunctiva and sclera, and results whenever the flow of blood through the conjunctival veins is impeded. The conjunctiva is raised up and appears like a translucent, jelly-like mass which may overlap the cornea or extrude between the lids. It occurs in some cases as the result of exposure of the eye or side of the face to a draught, as when traveling. It is not infrequently presented by elderly people with anæmia, heart or kidney disease, and a relaxed condition of the conjunctiva. In this case it is not troublesome, as it disappears in a few hours under the application of a compress bandage and the use of Apis or Arsenicum internally. When it accompanies inflammatory diseases of the cornea it becomes a serious complication, and injures the integrity of the eye by interfering with the circulation of blood through the tissues.

Emphysema is a rare condition, but may appear after inju-

ries to the conjunctiva, orbit, or operations upon the lachrymal ducts. The conjunctiva presents a colorless swelling which gives a slight crackling sensation on pressure. The application of a pressure bandage is all that is necessary.

HYPERÆMIA.

Hyperæmia of the conjunctiva may be acute or chronic. The acute form is the result of irritation, and disappears rapidly, or is followed by an inflammation. A chronic hyperæmia may develop slowly or follow conjunctival inflammation and persist for a long time.

Causes.—The causes of chronic conjunctival hyperæmia are, exposure of the eyes to irritating gases, smoke, dust, and bright lights, wounds, confinement in an impure atmosphere, or prolonged use of the eyes in a dull light. Any of these causes, if not sufficient in degree or amount to produce an active inflammation, when continuous in their action produce a chronic condition. Other fruitful causes are, errors of refraction, as hyperopia, astigmatism and beginning myopia, which produce eye strain, and also nasal catarrh. The hyperæmia is usually confined to the lid portions of the conjunctiva and has been termed *palpebral conjunctivitis.*

Symptoms.—The symptoms of hyperæmia are, injections of the arterioles of the conjunctiva, especially of the lids, the development of papilliform elevations at the edges of the tarsus and in the retro-tarsal folds, and an increased secretion of tears on using the eyes, with itching, pricking, sandy, dry or hot sensations, especially when the eyes are used for near work.

Treatment.—The removal of the cause is absolutely necessary. The eye should be examined for ametropia and glasses adapted and worn when refractive errors are discovered. Temporary relief may be obtained by the use of cold water. Bathe the eyes in a weak solution of salt and water, or allow a stream of water to play over the closed eyelids for a few minutes daily. If a weak collyrium is desired, sodæ-biboratis

gr. viii ad f℥i, or acid. boracic. gr. v ad f℥i will be beneficial. Internally, the administration of Acon., Gels, Ars., Euphrs., Bell., Caust., Dubois., Graph., Merc. sol., Nux, Sepia, and Sulph. may be called for. A careful consideration should also be given the remedies and their indications as mentioned under Muscular Asthenopia.

CONJUNCTIVITIS.

It is important to learn to distinguish the various forms of inflammation of the conjunctiva from each other, and from deeper affections of the eyeball. The characteristic features of inflammation are hyperæmia, or enlargement of the vessels, and a discharge which may consist of tear fluid mixed with epithelial cells, mucous or pus; in the deeper inflammatory affections, chemosis, hypertrophy of the papillæ, thickening of the mucous membrane from hypertrophy of the connective tissue elements, increase of the lymph follicles or new deposits of lymph corpuscles.

In inflammations of the cornea, iris, and some other tissues of the eyeball, the vessels appear deeper, straighter and more pinkish or purplish, and do not move with the movements of the conjunctiva.

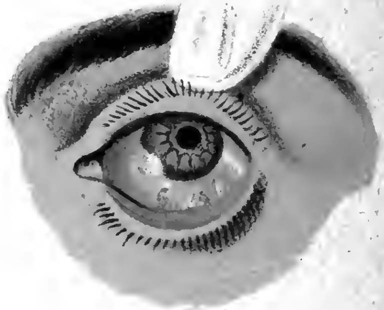
Conjunctivitis may present several varieties dependent upon the cause, grade of inflammation, and character of the discharge, and one variety may pass into another, or, the two forms exist at the same time. The varieties of inflammation are divided, from a clinical rather than a pathological standpoint, into catarrhal or simple; purulent, which includes ophthalmia neonatorum, gonorrhœal, croupous, diphtheritic and trachomatous; and follicular and phlyctenular. All varieties present secretions which are more or less contagious, and when introduced into the eye may occasion an inflammation of the same form from which the contagion is derived, or excite another variety of conjunctivitis. Hence the utmost care should be used to prevent the spread of the contagion, and when conjunctival diseases occur endemically in hospitals,

PLATE II

1

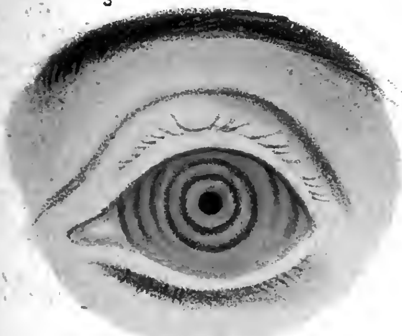
Conjunctivitis

2



Phlyctenular Conjunctivitis

3

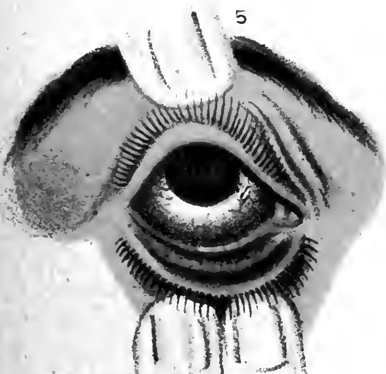


Purulent Conjunctivitis
(First Stage.)

4

Purulent Conjunctivitis
(Second Stage)

5



Granulated Lids

6

Pterygium

asylums, and other public institutions, isolation and the utmost cleanliness should be practiced in order to limit the extent of the epidemic; the disease, however, may be propagated by the atmosphere where the rooms are over-crowded and the ventilation poor.

CONJUNCTIVITIS CATARRHALIS.

Catarrhal or simple conjunctivitis is characterized by an injection of the vessels of the conjunctiva; it may be confined mostly to the lid portions or involve the whole extent of the conjunctiva, which becomes red from the injection. (Plate II, Fig. 1.) The papillary layer swells and more or less loss of epithelium occurs.

Symptoms.—The secretion is increased and contains mostly mucus and tears; later some pus cells appear and the discharge becomes muco-purulent. Small spots of ecchymosed blood in the ocular subconjunctival tissue are very common and characteristic of catarrhal conjunctivitis. The eyes appear suffused and the tears may run over the lids, and, if acrid, excoriate the cheeks; during the night, from evaporation of the more fluid portions of the discharge, the mucus thickens and collects upon the cilia and upon the edges of the lid and gluing them together makes it difficult to open the eyes in the morning until water is applied. If the attack is severe the conjunctiva becomes more swollen, but remains smooth; in some cases chemosis may be present and occasionally some febrile excitement. The patient complains of a scratching or sandy feeling, or as if the eye was full of sticks. A very common sensation is that of a foreign body under the upper lid and it is often a very difficult matter to satisfy the patient that such is not the case, even after the lid has been everted and the surgeon has determined that there is nothing but the inflamed conjunctiva to be dealt with. In some of these cases temporary relief occurs from the removal of a bit of stringy discharge which, from the motion of the eye, has been rolled into a thread-like mass and remains under the lid. Bright

lights become disagreeable and artificial light at night aggravates the condition of the eyes. The vision is sometimes made temporarily dim or foggy by the increased discharge passing over the cornea, and momentary relief comes from winking. In the more chronic forms the gluing together of the lids in the morning, the sandy feeling and aggravation from artificial light, and perhaps an itching or excoriation of the lids are all that is usually complained of.

CAUSES.—The causes of catarrhal conjunctivitis are very numerous. It more frequently arises from the presence and irritation of foreign bodies; the exposure of the eyes to cold, irritating vapors, dust, or chemical irritants, vitiated air, or sudden atmospheric changes. It is a frequent accompaniment of acute or chronic nasal catarrhs, inflammation of the lachrymal sac and blepharitis, and may be the result of eye strain in errors of refraction. It frequently appears during the eruption in scarlatina, measles and small-pox, and some chronic cases appear from the lax condition of the orbicularis which allows the entrance of air between the conjunctival surfaces of the lid and ball; and in other cases as a result of the alcoholic habit. All inflammatory diseases of the eye, except perhaps retinal or optic nerve affections, may occasion conjunctivitis.

DIAGNOSIS AND PROGNOSIS.—The diagnosis becomes difficult in many cases; the discharge will, however, differentiate it from other forms of conjunctivitis and from more deep-seated eye diseases, while the transparency of the cornea will not render it likely to be mistaken for corneal affections. The accumulation of the dried discharge on the lids may make it liable to be confounded with blepharitis, but the easy removal of the discharge, the clear condition of the skin, and absence of thickening of the lid edge will clear up all doubts. A chronic catarrhal conjunctivitis may be consequent upon simple conjunctivitis where the habits, low condition of the health, and long-continued use of the eyes at fine work, prevent a perfect restoration of the inflamed conjunctiva. The eye has a reddish, irritable condition, and the conjunctiva

becomes thickened and produces an increased mucous secretion. There is agglutination of the lids in the morning, or accumulation of dried secretion in the inner canthi. The thickening of the conjunctiva of the lower lid is apt to cause eversion of the lid, displacement of the punctum and overflow of tears which reddens or glazes the lid margins. The disease is often obstinate and may persist for a long time, and causes much discomfort by itching, watering, and irritation of the eye on attempting to read or do fine work.

TREATMENT must be directed in the first place toward the removal of all hurtful influences. Many cases recover without attention of any kind. When occurring during the progress of an eruptive disease it usually requires no special treatment beyond a moderate exclusion of the light; other cases disappear on the removal of the exciting cause. The possibility of a foreign body being still present beneath the lid must be remembered, the lid everted, and any foreign substance removed. In chronic cases inquiry in regard to the habit and diet will be necessary, and a better hygienic condition should be recommended, with a good and plentiful diet, pure air, and the avoidance of all alcoholic or malt liquors, particularly before retiring.

The remedial treatment consists in the judicious selection of remedies according to indications, the topical use of ice, and if desired, a weak astringent collyrium of borax gr. x, boracic acid gr. v, or sulphate of zinc gr. i, ad f℥j of rose water, or camphor water, may be employed with benefit.

REMEDIES.

Aconite.—Indicated in the beginning of conjunctival inflammation, particularly those forms arising from foreign bodies and from exposure to cold or dry winds. The conjunctiva is injected, perhaps chemotic, hot and feels dry, while the pain is often very severe or more of an aching character, with a sensation as if the eyeball was too large.

Belladonna.—About the same condition is presented as in Aconite but there is usually more photophobia and concomitant headache, flushed face, etc., which will distinguish it from Aconite during first stage.

Euphrasia.—Frequently indicated in both the acute and chronic forms. The conjunctiva appears very red and occasionally chemotic. The lachrymation in the early stage is profuse and acrid, while later, the discharge is profuse, muco-purulent, yellowish, and excoriates the lids and cheek. In other cases the discharge is very slight and blurs the vision by partially covering the cornea which is again cleared temporarily by winking.

Mercurius. — Very useful in various acute or chronic catarrhal affections, especially Merc. sol. or cor. The lachrymation is profuse, burning and acrid, and the mucous discharge also burning and excoriating. There is usually marked general redness of the conjunctiva and aggravation from artificial light. The condition is frequently aggravated at night and from cold damp weather. The pains are variable and there is not infrequently neuralgic pains in the forehead and temple.

Pulsatilla.—Useful in both acute and chronic varieties. The conjunctival hyperæmia is not usually intense. The pains may be burning, itching, or stinging and aggravated in a close hot room and in the evening, and are often relieved by the cool open air. The discharge is generally bland, whitish and muco-purulent and glues the lids together during the night.

Sulphur.—Often indicated in both the acute and chronic forms. The pains, redness and swelling of the lids are variable. The sensations are usually as if the eyes were full of sand or sticks, or burning and dry. Fine, sharp, darting pains through the eye are very characteristic.

Many other remedies may be occasionally useful, as Allium cep., Alum., Apis mel., Arsenicum, Arg. nit., Chloral, Graph., Hepar s., Ipecac., Ignat., Nux vom., Nat. mur., Rhus tox., Sepia and Terebinth.

VERNAL OR AUTUMNAL CONJUNCTIVITIS.

In the spring during the months of April and May, or in the fall during September of each year, an aggravated form of catarrhal conjunctivitis, which is more or less epidemic, appears in some localities, and seems to bear some close relation to the cause of rose colds and hay fever, and would also appear to depend upon atmospheric conditions.

SYMPTOMS. — The affection usually commences with an itching or pricking sensation of the conjunctiva at the inner canthus, and may affect only the conjunctiva at that point; or intense heat of the lid, and redness and swelling of the conjunctiva with a more or less muco-purulent discharge may follow, together with more or less intolerance of light.

The marked feature of these cases seems to be the paroxysmal itching and burning which occasions irresistible rubbing of the eyes, and this increases the irritation causing a sandy or scratching sensation. The tears or mucus which are poured out abundantly excoriate the cheek, and the lids may become swollen, red and œdematous. There is commonly more or less sneezing and nasal irritation which may be the initial symptom of an attack of rose cold or hay fever. The treatment is usually simple and requires the use of Aconite, Merc. sol., Euphras., or Sulph., with the topical application of a collyrium of borax.

There is another form of conjunctival infiltration termed *spring catarrh of the conjunctiva*, which is entirely different from that already described, in that, there is the conjunctival infiltration (Von Graefe), or a hypertrophy (Saemish, Burnett) of the conjunctiva over the ciliary region at the periphery of the cornea. The appearance is somewhat similar to the phlyctenules of the conjunctiva when forming a circle at this point. The conjunctiva is elevated and nodular or mound-like, or simply thickened. The extent of the infiltration may be from one to three mm. in width, and the conjunctiva of the bulb only slightly, if at all, injected. Changes occur in the corneal margin and in negroes the infiltration is often markedly

pigmented. Wanstall, of Baltimore, gives a report of cases observed by him and a resume of the literature of the subject in the *Transactions of the Hom. O. and O. Soc. 1880–1882.* The disease persists for months, but may finally disappear; local treatment is not indicated and Wanstall reports Merc. prot. as efficacious in the treatment of the disease. This affection has undoubtedly been mistaken for the ring form of phlyctenular inflammation occurring at the margin of the cornea.

ATROPINE CONJUNCTIVITIS.

A form of irritation and inflammation of the conjunctiva is occasioned not infrequently by the instillation of atropine, particularly in old people, and in some cases which do not seem to tolerate the use of atropine, which causes pain, smarting or itching when introduced. The conjunctiva becomes hyperæmic, thickened, injected, or roughened, and apparently granular, and there is either a secretion of tears only, or tears and mucus combined. The lids may be swollen or become hyperæmic, glazed or excoriated. The use of atropine should be discontinued and some other mydriatic, as duboisia, substituted. The discontinuance of the atropine and the use of a weak collyrium of borax or boracic acid will be all that is necessary. Where it seems desirable to use the atropine the addition of borax or boracic acid to the atropine solution will sometimes prevent the irritation from the use of the drug.

CONJUNCTIVITIS PURULENTA.

Blennorrhœaic inflammation of the conjunctiva is much more severe and dangerous than the catarrhal or simple form of inflammation.

Causes.—It may be idiopathic, or result from specific infection, or from inoculation by muco-purulent or purulent discharges from any form of conjunctivitis.

Symptoms and Diagnosis.—It is characterized by a profuse discharge of pus, and tense swelling of the conjunctiva. The

chemosis is a marked feature of the disease, and if the conjunctiva is at all lax the swollen membrane extrudes between the lids, puffs out as the patient looks downward, or overlaps the cornea like a circular cushion. The surface of the conjunctiva is generally smooth, bright red, tense and glistening, or in severe cases has a grayish or tawny color due to the fibrinous exudation into the subconjunctival tissue. The eyelids also become hard, thickened and present a livid appearance, while the upper lid becomes much increased in size and hangs down over the lower lid and is only capable of slight, or no elevation by the levator muscle. The secretion is thin and serous, or tinged with blood at first, often flaky, and running over the lid excoriates the cheek. After a few hours, or days, the discharge becomes markedly purulent; at this stage the appearance of the conjunctiva changes, it loses its glistening tense appearance, becomes more velvety, and presents numerous uneven folds from a hypertrophied condition of the tissue itself. The discharge is now a thick, creamy pus, and abundant.

Prognosis. — The prognosis is doubtful as regards the vision until the swelling has subsided, as the great danger in cases of purulent conjunctivitis is that the cornea will become implicated in the disease. During the first stage the cornea usually remains intact, but when the chemotic swelling is at its height, or as the disease begins to decline, the corneal danger becomes very great. The corneal complications are either marginal ulcerations, which may be transparent, purulent infiltration of its tissue, or complete suppuration and necrosis. As a rule, the later the corneal affection appears the more readily it responds to treatment.

The disease may be acute and run its course in six or eight weeks, and recovery take place without serious damage to vision and the mucous membrane return to its normal condition. In the majority of cases, however, if not properly treated, there is either loss of vision from corneal implication, or the disease becomes chronic and hypertrophy of the conjunctiva and development of granulations result.

Treatment.—The treatment consists in the utmost cleanliness, the constant and frequent removal of the discharge as it forms; the application of cold compresses, preferably the use of ice bags; if but one eye is affected, in protecting the other from infection by covering the eye as recommended in gonorrhœal ophthalmia; and the use of the proper medical remedy and such local adjuvants as may be useful in the different varieties.

According to the age and the contagion, purulent conjunctivitis has been divided into blennorrhœa of new-born babes or *ophthalmia neonatorum*, and *gonorrhœal conjunctivitis;* clinically, these varieties present little, if any, difference from the ordinary form of purulent conjunctivitis, except perhaps a peculiar malignity in some cases.

REMEDIES.

Aconite or *Bell.* may be indicated in the first stage according to the symptoms given under catarrhal inflammation.

Arg. nit.—The most useful remedy for any form of purulent inflammation as soon as the discharge has become established. There are no marked symptoms to indicate its use beyond those which characterize the blennorrhœaic process, as the swollen lids, chemotic conjunctiva and profuse creamy discharge.

Pulsatilla.—This remedy is next in importance in the purulent form of inflammation of the conjunctiva, and is often more useful than Arg. nit. in the latter part of the purulent stage, or when the latter remedy seems to have lost its effect.

Rhus tox.—In some cases of ophthalmia neonatorum where there is severe redness and œdema of the lids which are spasmodically closed so that the eye is opened with difficulty.

Chamomilla.—Sometimes useful when the conjunctiva bleeds easily, or there is blood mingled with the discharge, and the general symptoms of the remedy are present.

Calc. hyperphos.—Indicated in cases where there is faulty nutrition and where sloughing of the cornea has begun.

Hepar sulph.—May be indicated when the discharge is lessened, or the cornea becomes involved, or hypopyon has occurred.

Mercurius.—This remedy is indicated in the later stages of the disease, when the discharge has become thin and excoriating, or when there is inflammation of the cornea.

OPHTHALMIA NEONATORUM.

Blennorrhœaic or purulent conjunctivitis of new-born infants, is an inoculated form of inflammation of the conjunctiva, and when occurring, as it does very frequently, within three or four days after birth, indicates an infection at that time, or immediately afterward.

There are, however, other eye troubles of infantile life which do not take on a purulent form of inflammation and are not so serious, as they present the symptoms of simple conjunctivitis and require only attention to cleanliness for their relief. This fact, however, should not prevent the attending physician from making a personal examination of the condition, as these apparently simple cases may continue for weeks without much increased discharge, and the condition pass into one simulating granular lids or, more properly, hypertrophy of the papillæ of the conjunctiva of the folds and lids. The prescription of Aconite, Puls., Cham., and Sulphur may be of service to relieve this condition when detected early. If a wash is demanded, the use of borax or boracic acid solutions for washing the eyes several times a day and the application of cosmoline to the lid edges is all-sufficient to clear up these cases rapidly.

The early recognition of the purulent form of conjunctivitis is of the utmost importance as regards treatment and results, and when promptly recognized and properly treated the *prognosis* should be extremely favorable.

Causes.—The disease appears generally from the second to the sixth day and when occurring during this period is undoubtedly caused by direct local inoculation, either from the

gonorrhœal, or leucorrhœal discharge of the mother, during the passage of the child into the world. As a rule the more virulent the inoculating pus, the more early does the affection appear and the more violent the inflammation following. Where the disease appears after the first week of the child's life, other causes must be assigned for the affection. A small percentage of cases are undoubtedly due to the manual transfer of infected material by a careless nurse or mother; but such local irritants as cold, foreign bodies; chemical irritants such as soap, as well as atmospheric causes, also hold a causative relation to this disease.

Prophylaxis. — Among the prophylactic measures which should be exercised where we have reason to suspect this trouble, are first, those directed to the mother, and second, those to the child. When the mother presents an acrid leucorrhœal or gonorrhœal discharge, or a vaginal discharge of whatever character, the most scrupulous attention should be given to its correction prior to confinement. The use of cleansing lotions of large quantities of warm water, containing carbolic acid, boracic acid, sulphate of zinc, or glycerole of tannin, for several days prior to confinement will undoubtedly lessen the danger of infection. After the birth of the child and before the cord is severed, the physician should at once cleanse the eyelids with bits of soft linen, or absorbent cotton; remove all secretion from the cilia, and wash the eyelids and surrounding parts in a weak solution of boracic acid.

When we have reason to suspect that the danger of inoculation is probable, we should, as soon as the child has been otherwise cared for, evert the lids to discover and remove any of the unctuous leucorrhœal discharge which may have insinuated itself beneath the lid and found a resting place upon the folds of the conjunctiva.

Symptoms and Diagnosis. — The most typical cases of ophthalmia neonatorum occur from twelve to seventy hours after birth. Usually before the third day we find the eyelids somewhat reddened, slightly swollen and a slight flow of tears. Eversion of the lids will show bright red transverse lines

occupying the middle of the palpebral conjunctiva; shortly after this, the edges and angles of the lids become red and perhaps painful on pressure. The ocular conjunctiva is next to become involved; it appears bright red, and the swelling of the lids increases. The discharge which at first was almost entirely of tears, now becomes serous and gradually assumes the appearance of turbid whey. There is considerable photophobia which causes the infant to close the lids tightly so that some difficulty is experienced in opening them. This closes the *first stage*. The *second stage*, or that of suppuration is ushered in usually by a marked increase in the swelling of the lids. This swelling increases so rapidly that often in twenty-four hours they cannot be separated without considerable force. The upper lid usually overlaps the lower one and, in most cases, is so stiff that it is difficult or impossible to turn it. On separating the lids the exposed conjunctiva is thickened, perhaps raised in folds, and of a diffused bright red hue through which the sclera can be dimly seen. At first there is a muco-purulent coating over the entire conjunctival surface; the discharge soon becomes more abundant and decidedly purulent, and later is thick and creamy. The effusion of the conjunctiva is generally serous and causes chemosis and protrusion of the lids, but in some cases contains much fibrin, and the conjunctiva presents a raised and resisting surface; this condition arises more particularly in the course of gonorrhœal infection and is, of necessity, very grave, owing to the danger to the cornea from the compression of the vessels which supply it. When the effusion is very great the swelling of the ocular portion may extrude between the lids, and the palpebral swelling causes eversion of the lids, the latter giving rise to a spasmodic action of the orbicularis, or blepharospasm, which, by increasing the pressure upon the eyeball, causes increased danger to the cornea.

As the inflammation increases the secretion becomes enormous, considering the small area of the suppurating surface. The free edges of the lids are stuck together by the discharge drying upon them, and their separation causes the discharge

to gush out with some force, and oftentimes with danger to the operator. The cornea is thus kept macerating in the imprisoned pus. The cutaneous surface of the lids is livid, transversed by enlarged veins from the passive congestion. Early in the second stage it is usual to notice unmistakable signs of pain. There may be some marked febrile reaction, the child becomes restless and refuses the breast. If the local infection is slight, the child usually thrives. In the majority of cases of ophthalmia there is no further advance of the disease; the inflammation having reached its height now begins to subside, and usually results in complete recovery, without sequelæ. Some cases, however, pass into a chronic catarrhal inflammatory condition, and in others the papillæ become hypertrophied or true granulations result. If the cases do not end here, irreparable damage results from the *third stage* which is entered upon, in which we have involvment of the cornea in the affection. This complication is more frequently the result of gonorrhœal infection or of badly treated or neglected cases. The cornea may suffer only at small points or over its whole surface. The corneal affection usually appears in from eight to ten days after the disease has become established. The corneal epithelium is lost from constant maceration in the pus, and presents at first a hazy, or milky appearance, which soon becomes yellowish and finally ends in complete suppuration and, perhaps, loss of the lens, extrusion of the iris and atrophy of the bulb. If the disease is arrested before suppuration the eye recovers with a nebulous cornea, presenting much the appearance of ground glass; this condition may clear up very much owing to the activity of the absorbents in infancy, a result which may be hastened by the assistance of certain homœopathic remedies.

In another class of cases we may have one or more minute grayish points of corneal infiltration and softening which give rise to ulceration and perforation. In still others, the whole cornea may slough, as the result of the strangulation of the vessels by the chemotic swelling, so that on the second or third day the eye is entirely destroyed.

In the milder cases of strangulation, there may be one or more rapidly spreading central or marginal ulcers, which appear as if portions of the cornea had been chipped out, with clean-cut edges and transparent bases, which are difficult to detect unless viewed by oblique illumination. These are more difficult to heal than the others; the edges become rounded, blood-vessels develop in them and they rapidly fill up. As a rule, both eyes are affected simultaneously, or in rapid succession; at times, one eye is infected and the other remains free.

In all cases the eye should be carefully examined by the medical attendant, and to do this, the discharge should be carefully removed from the lid margins and lashes, and then the eyelids separated by the fingers applied above and below, or if necessary, small retractors should be used; having in this manner obtained a view of the whole of the conjunctiva, the cornea can also be thoroughly examined. The disease lasts from three to six weeks, and much longer if improperly treated, or neglected.

Treatment.—The eyes should be shaded from the light, but it is not necessary to confine the infant in a darkened room, rather place it in a light and well-ventilated apartment. The whole treatment hinges upon the frequent removal of the discharges, the eyes being constantly cleansed with scraps of old linen or bits of absorbent cotton, and the further cleansing of the eyes with solutions of chlorine water diluted one-half, boracic acid (gr. v. ad f℥i), or arg. nit. (gr. i. ad f℥i) injected into the eye from an eye dropper, and the use of vaseline to the lid edges will be sufficient to carry the majority of cases to a favorable termination without other remedies. The use of cold compresses is not applicable to such young infants, but in case corneal affections appear, frequent bathing of the eyes with warm water every five minutes during the day, and every quarter-hour at night, and the use of a solution of atropine (gr. $\frac{1}{8}$ ad f℥i), one drop every three hours, will be indicated. The careful following of the directions for the removal of the discharge and the

administration of Arg. nit., 6th to 30th, Puls., Merc. or Hepar sulph. will be sufficient to bring the cases to a favorable termination. Other remedies may be useful and their indications will be found under Conjunctivitis Purulenta.

GONORRHŒAL OPHTHALMIA.

This variety of purulent conjunctivitis is due to the inoculation of the conjunctiva by the secretion from an acute or chronic inflammation of the urethra, or vagina. The disease sets in from twelve to forty-eight hours after the contagion has been introduced into the eye, but if the discharge has become gleety, several days may elapse after the eye has been infected before inflammatory symptoms appear.

SYMPTOMS AND DIAGNOSIS.—The primary symptoms are slight itching and redness of the conjunctiva, followed almost immediately by intense congestion, with a bright, almost scarlet, chemosis of the conjunctiva. The discharge, which at first is serous, rapidly becomes turbid with whitish flakes of pus and epithelial cells. The lids become swollen and injected. The pain is often intense from the pressure upon the branches of the fifth nerve by the fibrinous exudation which infiltrates the sub-conjunctival tissue. This constitutes the *first* or *infiltration stage* and the appearance of the eye is well portrayed in Plate II, Fig. 3. This stage reaches its height in from two to three days, when the *second stage*, or *that of purulent discharge*, occurs. The lids become more swollen, hard, tense and often livid, rendering it impossible to open the eye, while the upper lid hangs down over the lower as shown in Plate II, Fig. 4. The conjunctiva becomes roughened and velvety from loss of the epithelium and the discharge becomes thick, creamy, yellow, or, perhaps, slightly greenish. The secretion is now very profuse and collects in drops on the cheek at the edges of the upper lid as shown in Plate II, Fig. 4. The patient suffers severely from the pain in the eye and around the orbit, and complains of much heat and fullness of the lids and globe.

Prognosis and Complications.—The disease is very rapid in its progress and very destructive and unless properly treated and soon checked, the eye is lost. It usually reaches its height in from ten to twelve days while the duration of the disease may be from four to eight weeks. The great danger is from corneal complications which arise from interference with the nutrition of the cornea due to the compression of the blood-vessels at its margin by the dense chemosis which rises above the level of the cornea and often overlaps it. This complication does not usually occur until several days after the inception of the disease and often not until signs of improvement in the discharge appear. As a rule, the greater the chemosis, the greater the danger to the cornea. Frequently a narrow marginal ulcer appears which tends to extend insidiously around the periphery of the cornea, or parallel to it, partially concealed by the overhanging chemosis; the central portion of the cornea appears bright and clear, and the danger may not be realized until the ulceration has extended over one-half or two-thirds of the circumference, when the central portion suddenly becomes opaque and sloughs. In other cases the whole surface may become grayish and infiltrated from maceration in the pus which accumulates and is allowed to remain in the basin-like depression caused by the chemosis. At other times, the morbid process commences in a small spot at the margin, or at any part, and rapidly extends until the whole, or the greater portion of the cornea is involved. The cornea may perforate and the iris prolapse, iritis, or suppuration of the interior of the eye occur; or, if the cornea slough, the lens, and even the vitreous, may follow, and there is a sudden relief of the pain and tension, which is regarded as a hopeful symptom by the patient, but as a disastrous one by the surgeon.

As the disease is characterized by a general hypertrophy of all portions of the conjunctiva, it tends to run into a chronic stage, the papillary structure of the tarsal conjunctiva retaining this thickened, almost warty, condition with more or less discharge, or finally trachoma or granular lids develop.

Treatment.—The utmost promptness and closest attention are necessary to save the eye. In the first stage the continual application of cold either in the form of light compresses, chilled on a block of ice at the bedside, and changed every minute, day and night; or whenever possible the application of ice-bags, which are replaced as often as the ice melts. No other application should be made during this stage beyond a solution of boracic acid gr. v ad f℥j, or chlorine water, diluted one half. Nitrate of silver should never be used in this stage. In the second stage, the use of nitrate of silver solutions may or may not be indicated and, if used, the behavior of the eye after the first application will determine its future use. If the secretion is creamy and profuse and the conjunctiva velvety, the application of a solution of gr. xx ad f℥i which is lightly applied to the everted lids and quickly washed off by a camel's-hair brush with water or milk may be used. The pain will be increased for an hour after the application, but is relieved by the application of the ice bags. The immediate effect of the use of the solution will be to stop the discharge for several hours. If the discharge and swelling are lessened the next day, it is probably well indicated, and the application may be repeated after twenty-four hours. The use of nitrate of silver requires close observation, and if the swelling becomes more tense, or if the cornea show signs of infiltration, its use must be abandoned.

In the second stage, absolute cleanliness is necessary and the discharge must be removed as often as it accumulates, night and day, and to do this thoroughly and well the attendants should be provided with a box of small squares of old muslin, or with absorbent cotton, with which the discharge can be constantly removed, and the cloths or cotton deposited in a receptacle to be afterwards burned, to prevent further infection. To cleanse the eye properly, the lid should be everted, and a camel's-hair brush wet with boracic acid solution, or chlorine water, applied to the conjunctiva and particularly to the folds, until all discharge is removed; this can be rarely trusted to an attendant unless he be a skilled nurse, but should

be done at least twice a day by the medical attendant, and the eye kept free of the discharge at least every half hour during the interim, or oftener, if the discharge is very profuse.

If but one eye is affected, as is usually the case, the protection of the other is of the greatest importance, and for this purpose, the sound eye should be covered with a watch crystal set in a piece of rubber plaster which is affixed securely to the bridge of the nose and the eyebrow and cheek, which allows the patient to open the eye and at the same time permits a full inspection of its condition. It is not well to close the eye by bandaging, or by the application of plasters, as the discharge oftentimes soaks through and the eye becomes inoculated and the morbid process well advanced before the condition is discovered. If the cornea becomes implicated atropine (gr. ii. ad f℥i.) should be instilled every two or three hours, and if the lids are very tense and greatly swollen so as to cause pressure upon the cornea, canthotomy should be performed. It may be necessary to puncture the base of the ulcer with a cataract needle, or perform paracentesis of the cornea, if perforation is imminent. The cold applications which may have been used up to this time, must be stopped and warm compresses applied. The use of Hepar sulph., Calc. hyperphos., and Mercurius will prevent materially the further destruction of tissue.

The indications for this form of conjunctivitis have already been given under Conjunctivitis Purulenta.

Croupous or Membranous Conjunctivitis can scarcely be termed a distinct form of conjunctival inflammation, since it may occur as a complication of any form of blennorrhœa of the conjunctiva, the pus becoming plastic or fibrinous in character so that it adheres to the membrane, or forms shreds or rolls, and is peeled off in masses, leaving the conjunctiva excoriated and denuded of epithelium and often bleeding. It is seen more frequently in infants and young children, and requires no special treatment beyond that indicated for the relief of the purulent inflammation which accompanies, or rapidly follows it. The use of chlorine water seems to be

particularly useful in this condition, and the lids should be everted and the membrane thoroughly removed by the brush as fast as it forms. The appearance of this fibrinous condition of the pus always contra-indicates the use of nitrate of silver solutions. The frequent cleansing often destroys this feature of the affection, and the membrane will not form unless the cleansing process is stopped for a few hours. This form of discharge may indicate the use of Acetic acid, Apis mel., Hepar, or Kali bich.

CONJUNCTIVITIS DIPHTHERITICA.

Diphtheritic Conjunctivitis is a rare affection in this country, but occurs epidemically in Northern Europe, and is not to be confounded with the croupous form just described. I have seen but three cases of this disease; two resulting from the extension of the diphtheritic membrane from the nasal cavity to the eye, and the third the result of direct contagion by means of a handkerchief, which had been used by a patient suffering from faucial diphtheria.

Symptoms and Course.—The disease usually commences suddenly, and the eyelids become red, swollen and rigid from the fibrinous exudation into the subconjunctival tissue. The chemosis presents a more grayish appearance than in the purulent conjunctivitis, and is tense and hard. As the disease advances, the swelling and redness of the lids increases, and the pain and heat is very great. The discharge is mixed with floculi of lymph, and is thin and gruel-like; this after a few days becomes purulent and the tissues of the lid become more soft. During the progress of the disease fibrinous exudation takes place in the conjunctiva of the lid, or upon the globe, either as small isolated gray patches, or as a continuous membrane which is removed with much difficulty, and leaves a depression in the conjunctiva. The lids are stiff as well as swollen and it is almost impossible to evert them. The disease may be constitutional as well as local and febrile disturbance and prostration exist. The plastic stage is succeeded by a

stage of partial resolution, the membrane is thrown off and leaves an ulcerated condition, the discharge becomes purulent, and the eye may pass through the various stages of blennorrhœaic inflammation. The cornea becomes implicated early and the general tendency of the disease is to complete destruction of the eye. Even if the vision is retained the entropium, or ectropium, of the lid from cicatrization and contraction becomes very serious.

The disease is contagious and, when affecting only one eye, the other must be protected as in the purulent forms of inflammation.

TREATMENT.—The treatment is often powerless to prevent the destruction of the eye. The use of ice-bags in the early stages of the disease is of the utmost importance, and if the pains caused by their application are very great, the use of chloroform or morphine may be necessary to allow of their continuous application. Spraying the eye with cold chlorine water has proved beneficial when the weight of the ice-bag could not be tolerated. Disinfectants may be advantageously applied in sweet milk, as besides being more soothing to the eye than water, it also gathers up the portions of the membrane as they are thrown off. When the stage of purulence appears, it is better to omit the cold compresses and apply warm fomentations to assist in the elemination of the fibrinous deposits.

The corneal complications demand the same treatment which appertains to similar affections under ordinary circumstances.

The general condition must be considered and strong diet and stimulants will be needed to sustain the strength of the patient.

For the remedial treatment, the use of Bell. and Rhus tox. will likely be indicated in the early stage of the disease. In the purulent stage better results will be obtained from Merc. cor. and Silicia than from Arg. nit.

CONJUNCTIVITIS TRACHOMATOSA.—TRACHOMA.

GRANULAR LIDS (Plate II, Fig. 5) is one of the most destructive and obstinate affections that the ophthalmic sur-

geon is called upon to treat. It depends upon a deposit of lymph corpuscles which accumulate in small masses beneath the epithelium or infiltrate the tissue of the conjunctiva. These granular masses may exist for a long time without causing irritation, or may arise spontaneously through conjunctival inflammation, or result from an attack of purulent ophthalmia. If the lids are everted, their inner surfaces are seen studded with these round, often yellowish, or red, granulations which are more abundant in the retro-tarsal folds. (Fig. 87.) It is not to be mistaken for the hypertrophied papillæ which are present in all cases of purulent conjunctivitis. In the latter, while the conjunctiva is thickened, if the finger is applied it feels soft and velvety to the touch, while in trachoma the conjunctiva is smooth, but the granulations feel hard to the finger. The granulations spread from the retro-tarsal folds to the other lid portions of the conjunctiva, but rarely invade the ocular portion; the latter, however, may become hypertrophied from the constant irritation of the granulations upon the lid. As the disease progresses the papillæ and subconjunctival tissue of the lids become changed and the inflammatory process causes a growth of connective tissue which destroys the integrity of the conjunctiva, and is afterwards partly absorbed, and partly converted into dense scar tissue, which, as it slowly contracts, occasions changes in the curvature of the tarsus and consequent distortion of the lid.

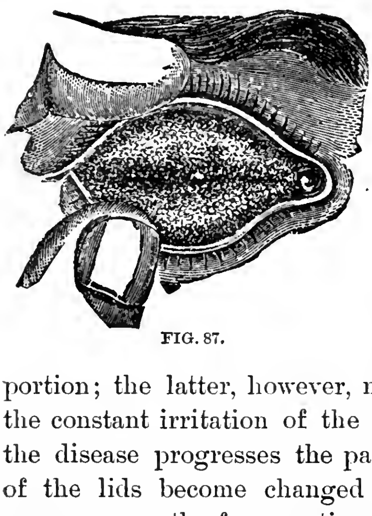


FIG. 87.

Causes.—The spontaneous cases of trachoma seem to result from unfavorable hygienic conditions, want of cleanliness and overcrowding, and a damp or vitiated atmosphere, hence it occurs in military barracks, workhouses, schools, asylums and public institutions which contain a large number of inmates. It is frequently the result of neglected catarrhal

conjunctivitis, and often follows purulent forms of conjunctival inflammation. A low condition of the health undoubtedly increases susceptibility to it, and it is common and easily produced in ill-nourished children with bad hygienic surroundings. Damp, and low lands or flat countries, as our western prairies, with severe winds during much of the year, seem to produce it in patients whose general health has been reduced by exposure, and want of proper food, or clothing. It is a very common disease among the Jewish and Irish races, while the Negroes seem to enjoy immunity from it. When accompanied by discharge the disease is contagious, and is spread very commonly by the use of towels and water which have been infected by the discharge. The sources of contagion, however, are endless and the disease is often disseminated in hospitals, barracks, etc., through the confined atmosphere.

Symptoms and Diagnosis.—If the disease arises spontaneously, or is idiopathic, and takes a chronic course it occasions but little discomfort beyond that which occurs in catarrhal forms of conjunctival inflammation. During the first stage a mucous, or in severe cases a muco-purulent, discharge is present which is not profuse, and only disturbs the patient by clouding the vision by covering the cornea, or evaporating during the night and so gluing the lids together, or the lids become thickened and heavy so that the levator is no longer able to raise them and a partial ptosis occurs. This condition may last for months or years without causing sufficient trouble to the patient to necessitate his seeking advice. If, however, he is exposed to cold, or the weather is raw and damp he may have an acute inflammatory condition set up, and the conjunctiva becomes very red, thickened, chemotic and perhaps the lids œdematous, and a profuse muco-purulent discharge follows, the condition becoming one of *acute trachoma* or *acute granulations*, and the cornea becomes implicated. This stage, however, soon passes away and the chronic condition is resumed.

Acute trachoma is a rare condition, but does occur; the soft smooth conjunctiva becomes rapidly transformed into a

hard nodular tissue with few blood-vessels and the secretion is much increased and half purulent.

The second stage is characterized by the formation of cicatricial tissue, and the granular bodies either disappear and leave tendinous bands running through the conjunctiva, or there is a fatty degeneration of the deposits.

During the progress of the disease acute exacerbations from cold, exposure, or irritation, are the rule, and with each occurrence there is a general aggravation of the whole condition, and increased tendency to corneal or other complications with increased discharge. The results and complications of trachoma are numerous and severe; they consist of haziness, opacity, ulceration and vascularity of the cornea, trichiasis, distichiasis, and entropium, and destruction and atrophy of the conjunctiva. During the course of trachoma the cornea almost invariably suffers from friction of the granulations of the upper lid; or where there is much scar tissue in the conjunctiva, the cornea becomes hazy from destruction of the epithelial layer; or corneal ulcers may occur and result in perforation or iritis. The most common complication is a vascular haziness which commences at the upper edge of the cornea and spreads until the upper half, or often the whole of it, becomes covered with an opaque red coating. This consists of the development of a layer of new tissue with large blood-vessels just beneath the epithelial layer of the cornea, and known as *pannus*, or *pannus crassus*. This condition may also arise in the later stages of the disease from inversion of the cilia. As the granulations subside and the irritation is removed, the pannus may disappear entirely, if Bowman's membrane has not been implicated, and the cornea becomes clear again. In the majority of cases a haziness, or if there has been ulceration, an opacity remains, or there may be fatty degeneration of the epithelial layer, and a thin whitish film will cover a portion or the whole of the cornea, which appears hazy and dry, the condition known as *pannus sicca.* In the later stages of the disease, as the inflammation subsides, the lymph corpuscles are replaced by cicatricial tissue which may

seam the inner surface of the lid in all directions, and in shrinking affect the deeper tissues, and this leads to distortion of the edges of the lid, and misdirection and changes in the eyelashes so that some, or all of them, are directed more or less inward and cause trichiasis and distichiasis, which also result in pannus. Again this contracting tissue increases the convexity and apparently lessens the size of the tarsus of the lids and causes entropium. When the disease has advanced to its last stage the conjunctiva is found atrophied, the retro-tarsal folds have disappeared and perhaps have been replaced by dense fibres of scar tissue, and the glands which moisten the conjunctive have become involved in the destructive process and the conjunctiva becomes dry as in the condition known as *xerosis.*

Amyloid degeneration of the conjunctiva is a very rare disease which occurs as a sequela of trachoma. It may occur in the folds, or, as in the only case I have observed, upon the conjunctiva bulbi near the upper fold, and appears as a thick jelly-like mass, yellowish in color which may be of sufficient size to extrude between the folds, and requires incision for its relief or removal.

TREATMENT.—Granular lids, if presenting an acute inflammatory condition, require similar local and internal treatment to that recommended for purulent conjunctivitis. In the chronic form the inflammation is more asthenic in character and treatment must be adopted to allay the inflammation and also produce absorption of the granulations.

In all cases the hygienic surroundings, cleanliness, pure air, and a generous diet, together with measures suitable to improve the low debilitated condition of the patient which is generally present in this affection must receive attention. The avoidance of exposure to damp and cold, and bright lights and irritants should be insisted upon. The utmost cleanliness of both the eyes and the person are necessary, and care must be taken to prevent the spread of the contagion to others; where cases occur in hospitals or public institutions they should be isolated in separate rooms, and provided with towels and

basins for each individual. If there is an endemic tendency, the other inmates should be examined every few days, or weeks, as the disease may appear, particularly in children, without much external manifestation.

The direct treatment of the disease consists in the local application of such irritating remedies as will stimulate the action of the absorbents of the conjunctiva and thus cause a removal of the deposits of lymph corpuscles. The agents which have been recommended and used for this purpose are almost numberless. In considering the applicability of caustics in this disease, it should be borne in mind that the conjunctiva does not present an ulcerating surface like a wound, and the granulations of trachoma are not similar to those of a suppurating surface, but penetrate deeply into the conjunctival tissue, and do not admit of destruction by caustic application without an accompanying loss of tissue, which renders the resulting condition of the eye more serious in many cases than it would have been had the disease been allowed to run its course without treatment. There is no single agent which will be universally suitable, and individual cases often require the rotation of local applications. As a rule it may be stated that the more irritable the eye is, the more mild the application should be, so as not to excite increased inflammatory action which too often results in increased deposits of the lymph cells.

The most commonly recommended application in these cases is the sulphate of copper crystal which is lightly applied to the conjunctiva daily or tri-weekly. Again, nitrate of silver either pure or combined with nitrate of potash in the mitigated stick is much lauded by some surgeons; where I find it advisable to use copper I prefer the aluminate, but this is also too severe for the majority of cases. A careful observation in my own practice of the effects produced by these agents leads me to believe that they more frequently injure rather than benefit. The topical application of cold by means of ice-bags, in both the acute exacerbations and the chronic conditions, for several hours each day and the use of tannic

acid and glycerine (gr. xv ad f℥i), carbolic acid and glycerine (gtt. II-III ad f℥i), or a solution of nitrate of silver (gr. v to x ad f℥i) applied to the everted lids by means of a camel's-hair brush, once daily, accomplish all that can be done towards hastening the absorption of the deposits. Occasionally the instillation of the watery solutions of tincture of Aconite, Hydrastis, or Sanguinaria, (gtt. x to xv ad f℥i) seems curative. Recently good results have been attained by the use of a decoction of the seeds of the *abrus prœcatorius*, or *jequirity*. A concentrated solution is dropped into the eyes once a day for three successive days. The *jequirity* produces several hours after its introduction an intense and painful inflammation, when a strong solution is used. If a milder solution is used there may be only heaviness of the eyelids, burning, lachrymation, and injection of the conjunctiva or headache. To derive any satisfactory benefit from its use, a sufficiently strong decoction must be employed to excite a purulent conjunctivitis, similar to that from inoculation, but which is more readily controlled than the latter. The application requires the greatest care and circumspection and is a remedy which can only be applied by the ophthalmic surgeon with any degree of safety. Much more reliance should be placed upon the administration of remedies, particularly for the acute attacks, and also in those cases exhibiting that irritable condition which does not tolerate the use of local adjuvants. The remedies most frequently indicated are Aconite, Euphras., Merc. bin., Merc. prot., Rhus, Calc. hyperphos., Ars., and Sulphur.

Pannus requires no special treatment as it generally yields to the treatment of the granulations. If there is much pain with the condition atropine should be used. It is often an indication for the use of Merc. prot., both internally and externally, in the latter case combined with vaseline (gr. ii ad ℥i), or Aurum met. may be used in some cases with great benefit. When the pannus remains after the granulations have disappeared, the *operation of periotomy*, which consists of the removal of a circular ring of conjunctiva 4 mm. broad from

the globe at the junction of the cornea and sclera, will cause a disappearance of the blood-vessels from the cornea. In cases of inveterate pannus the inoculation of the conjunctiva with pus from a purulent conjunctivitis has been recommended, but it is of very doubtful utility as well as dangerous. Ulcerations of the cornea require prompt attention to prevent perforation and may require the use of atropine or eserine together with the use of the bandage, and Merc. nit. internally, and externally a solution of the 1x gr.v ad f℥i will give good results.

If trichiasis or entropium result a suitable operation is to be performed for their relief.

For the xerosis or dry condition of the cornea which results in some cases from the almost complete atrophy of the conjunctiva nothing can be done beyond the frequent application to the eye of some oily substance as castor oil, olive oil or vaseline.

FOLLICULAR CONJUNCTIVITIS is an affection which is frequently classed with trachoma, but it would seem to be a distinct disease. It is characterized by the appearance of numerous hemispherical translucent vesicles which occur in the folds of transmission of the lower lid, rarely upon the tarsus, and, in less number, upon the conjunctiva of the upper lid where they are also more numerous at the folds. Pathologically, they appear to be swelling of the lymphatic follicles of the conjunctiva, and not simply deposits of lymph cells as in trachoma, although the two conditions are often present in the latter disease.

Unfavorable hygienic conditions and defective nutrition seem to be the most frequent cause of these follicular swellings which occur commonly in children and young people. There is slight, if any, discharge, and the patients may complain of no symptoms beyond those of simple hyperæmia of the conjunctiva; the condition may be present for a long time without occasioning any trouble and does not produce pannus, but seems to cause a predisposition to other troubles of the conjunctiva on slight irritation.

The treatment consists in the use of Nat. mur., or Ruta grav., and a collyrium of boracic acid.

CONJUNCTIVITIS PHLYCTENULARIS.

Phlyctenular or Pustular Conjunctivitis (Plate II, Fig. 2) is a recurrent form of inflammation, characterized by the appearance of one or more vesicles or papules upon the ocular conjunctiva, supposedly around the terminal filaments of the branches of the fifth nerve, and often occurring near the cornea. Each papule or phlyctenule forms a small patch of localized congestion towards which converge a leash of vessels which can frequently be traced back to the folds of the conjunctiva. These phlyctenules may present a semi-transparent or yellowish elevation or be more flat, large, and give the appearance of gelatinous infiltration at that point. There may be one or many scattered over the ocular conjunctiva or aggregated at the corneal margin, or they may encircle it and appear upon the cornea also. In a few days these vesicles which form the summit of the phlyctenule rupture, and leave a shallow ulcer with a yellowish base which heals in a few days. In some cases small points of congestion only, appear and after a short time subside without the formation of a vesicle. The pain is usually very slight, the photophobia or dread of light variable, and in some cases very slight, in others, intense and accompanied by severe blepharospasm. The secretion is commonly scant and mucoid in character.

The disease shows a great tendency to recur and the phlyctenules appear in successive crops after the lapse of weeks or months. They are very prone to appear in the winter and spring. Children have a peculiar liability to the disease, as it is only rarely seen in adults, and may be considered as indicative of some derangement of the general health. It is common to delicate and ill-nourished children, particularly those who live upon an almost exclusively starch diet, or use tea and coffee.

Treatment.—The treatment consists in the improvement of

the general tone of the patient, and the restriction of such nerve stimulants as tea and coffee. The patient should be urged to live upon a more mixed diet, as many cases cannot be cured until a moderate amount of meat enters into the daily nourishment. External applications are rarely necessary as the cure is much more rapid and permanent by the use of internal remedies than with topical applications. Of the latter, those which are generally recommended are the yellow ointment, a small bit of which is introduced between the lids and allowed to melt upon the conjunctiva, or calomel dusted into the eye, or solutions of merc. nit. dropped into it.

REMEDIES.

Sulphur.—Very frequently indicated in cases occurring in scrofulous children. Its sphere of action is very wide and suits a great variety of cases of pustulous inflammation of the conjunctiva, and is particularly indicated when there are sharp, darting lancinating pains, or as if pins and needles were sticking in the eye during the day, or the pains aggravated after midnight. There may also be itching, often a thickened condition of the lid and much rubbing of the eyes. The photophobia is variable and may be quite marked in the morning. The lachrymation is usually profuse and the lids generally stick together on wakening. There is often an eczematous condition of the lids, face and head, and a general aggravation from the application of cold water, or from bathing the eyes.

Pulsatilla.—The phlyctenules are more frequently small but often numerous; the photophobia or pain are commonly slight and the redness variable. The lachrymation and discharge are moderate and bland, although it is not contra-indicated if the secretions are profuse. Particularly suitable to the blonde women and children upon whom Pulsatilla seems to have so good an action.

Mercurius sol.—A valuable remedy in many cases of phlyctenular inflammation in strumous or syphilitic children. There is usually marked redness of the conjunctiva, and violent

photophobia, so that all light must be excluded, and the discharge usually thin and acrid. The pains are severe and neuralgic in character, affecting the temporal side of the head and face. They are variously described as burning, sharp, tearing, and lancinating, and aggravated in the evening and from exposure of the eyes to artificial light, by heat and damp weather, while there is a temporary relief from application of cold water to the eyes. The lids are often thick and swollen and spasmodically closed and excoriated by the discharge.

Merc. cor.—Indicated in the aggravated form of inflammation occurring in scrofulous children. The symptoms are much more marked than in the other preparations of Mercury, the pains, photophobia, lachrymation, all being aggravated; the nostrils are often excoriated by the acrid discharge from the eye passing down into the nose.

Mercurius dulcis.—Although calomel is used very extensively by the old school in scrofulous ophthalmia it is but rarely applicable to phlyctenular inflammation; some cases occurring in pale, flabby subjects, with excoriation of the nose, and swelling of the upper lip, have been benefited.

Mercurius nit.—This remedy, recommended by Dr. Liebold, has been used by him with remarkable success in a great variety of cases of phlyctenular inflammation. It seems to suit severe as well as mild affections, acute or chronic, with, or without much photophobia, and in some cases presenting severe pain, in others where the pain is absent. It may be used both internally and externally. If externally, ten grains of the first decimal trituration is to be dissolved in two drams of water and applied two or three times a day.

Graphites.—This is one of the most valuable remedies we have for all forms of phlyctenular inflammation. It is useful in both the acute and chronic forms, particularly in cases where there is a marked tendency toward recurrence. It is specially indicated in scrofulous cases, or with exanthematous eruptions about the head or behind the ears, particularly where the eruptions are glutinous, fissured and bleed easily. The photophobia is usually very marked, and the lachryma-

tion profuse, although in some cases nearly or entirely absent. There is generally a greater aggravation from sunlight than gaslight, and in the morning, so that often the child cannot open the eyes before nine or ten o'clock. The conjunctiva is frequently very red, and the discharges are muco-purulent, constant, thin and excoriating. The pains are variable and not characteristic; the lids are sore, red and agglutinated in the morning, or else covered with dry crusts, while the external canthi are fissured and bleed easily upon opening the eye. There may be also an acrid discharge from the nose accompanying the eye affection.

Calc. carb.—Phlyctenules appearing in fat, unhealthy children, with pale flabby skin and enlarged glands. The photophobia is often excessive, and the lachrymation very great and often acrid. The redness and pains (sticking in character) are variable and the lids perhaps swollen and glued together in the morning.

Calc. sulph. — Will prove exceedingly valuable in many cases when the general symptoms of calcarea are present with enlargement of the cervical glands. The lower attenuations should be used.

Hepar sulph. — Is adapted to phlyctenular inflammation occurring after measles, or in strumous children, when there is intense photophobia, lachrymation, an injection of the conjunctiva, with swelling of the lids, sensitiveness to touch and a desire to have them covered, and when the external canthi bleed easily on opening them.

Arsenicum.—Cases occurring in thin, ill-nourished children, without marked inflammatory symptoms. There is usually intense photophobia, and profuse, acrid lachrymation. The phlyctenules tend to form ulcers which extend superficially and take on an indolent character.

Rhus tox.—When there is excessive photophobia, lachrymation and spasmodic closure of the lids. There is generally a vesicular or pustular eruption upon the eyelids or face.

Antim. tart., Ipec., Kali bi., Mez.. Crot. tig , Euphrasia, Sepia, and Baryta, are also serviceable in phlyctenular conjunctivitis and will give prompt results when indicated.

Inflammation of the Caruncle occurs in rare instances and is characterized by an enlargement of the gland, and in one case I have observed suppuration. The caruncle is commonly involved in conjunctivitis, or inflammation of the semilunar folds, which occurs in some instances from acute exacerbations of chronic nasal catarrh.

Arg. nit., internally, with a mild astringent lotion, are usually sufficient to relieve the condition and prevent the extension of the inflammation to other portions of the conjunctiva. The caruncle is sometimes the seat of hypertrophy, becoming so large as to extrude between the lids; the use of tannic acid and glycerine locally and Calc. iod. internally caused the enlargement to subside in one case. The hypertrophy should not be excised, as the puncta might be displaced by the subsequent atrophy.

Calcareous masses sometimes form in one of the numerous meibomian glands which compose the caruncle and an incision and removal of the accumulation is all that is necessary.

Polypi sometimes spring from the caruncle and may be cut off with a pair of scissors; the hemorrhage, which may be profuse, is controlled by the pressure of a wad of absorbent cotton upon it for a few moments.

Pterygium (Plate II, Fig. 6) consists of an hypertrophy of a portion of the ocular conjunctiva and subconjunctival tissue, which is often very vascular, and has usually a triangular shape, the base of the triangle being towards the canthus, or retro-tarsal fold, and the apex extending upon the cornea. Its most frequent seat is at the inner canthus, but it may appear at the outer, or above or below the cornea; as it increases in size it extends more and more over the cornea. Its growth is slow, but it is often subject to attacks of inflammation which result in its more rapid advancement.

Causes.—It is occasioned by the irritation of dust or wind in adults who are exposed to the changes of the weather. In some cases it is caused by the overlapping and adhesion of the conjunctiva to an ulceration of the cornea near its margin. The dragging of this portion of the conjunctiva on motion of the eye results in a thickening of the tissue.

Treatment.—Zincum, Sulph., Calc. carb., Chimaphila, and Rhatania, are reported as having cured some cases, but a thorough trial has failed to find absorption follow their administration in marked cases. Where the growth has encroached much upon the cornea it is better to remove it by an operation. For this purpose the procedure of Arlt answers well. The pterygium is seized at the apex by a pair of fixation forceps and the portion overlying the cornea carefully dissected off with a Beers' or bent knife, then with a pair of sharp-pointed scissors the growth is separated from the conjunctiva on each side and cleanly dissected up from the sclera for a distance of nearly half an inch, the conjunctiva on the sides of the wound being loosened from the globe sufficiently to enable the edges to be brought well together and united by one or two sutures, and the pterygium then left to atrophy.

If the mass is very thick or broad it is better to dissect it up to the inner canthus, excise it, and bring the conjunctiva together as before. If the growth is narrow, good results are obtained by dissecting it up as before, and then making a longitudinal incision in the conjunctiva below the cornea and turning the pterygium down and stitching it there, where it soon atrophies. The conjunctiva is then brought together over the space from which it was dissected, the eye bandaged, or cold water compresses applied, and the sutures allowed to remain for three or four days. If the growth is very large there is danger of eversion of the lid from its transplantation in this manner.

The operation for ligation is no longer practiced, as it is very painful and comparatively useless.

Symblepharon, or union of the conjunctiva of the lids to that of the globe, (Plate II, Fig. 5,) is the result of burns or other injuries which destroy portions of the conjunctiva, so that adhesion takes place by cicatricial bands notwithstanding the efforts made to prevent such occurrences by the methods already described in discussing injuries of the conjunctiva. If the extent of symblepharon is great, the movements of the eye are interfered with, and it occasions much irritation which

may destroy the vision or excite sympathetic inflammation of the other eye.

Treatment.—If the adhesions are small, they may be divided with the scissors or knife, and re-union prevented by the instillation of castor oil or vaseline, and the frequent drawing of the lid away from the ball until the wound is healed; or the conjunctiva of the bulb may be loosened around the cicatrix and brought together, so as to cover the raw surface. For more extensive cases, the operation devised by Teale will be found useful. An incision is made as in Fig.

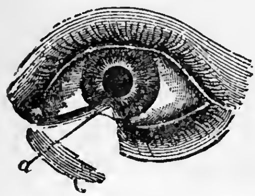


FIG. 88.

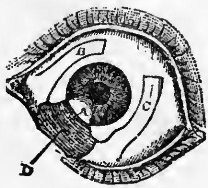


FIG. 89.

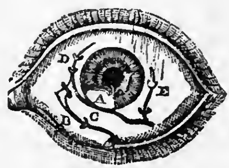


FIG. 90.

88 in a curved line corresponding to the margin of the partially covered eyeball, while the portion *A* on the cornea (Fig. 89) is allowed to remain; two conjunctival flaps *B* and *C* are then made of sufficient width and breadth to cover the raw surface at *D*, and gently turned down and secured in position by fine sutures, and the gap left by the transplanted flaps also closed by sutures, as in Fig. 90. Dry dressings are then applied. In some cases the grafting of a portion of the conjunctiva of a rabbit is successful.

Tumors of the Conjunctiva rarely occur except by extension from adjacent tissue.

Polypus arises occasionally at the inner canthus or from the stump of the muscle after tenotomy. Calc. carb. internally is reported as having cured polypus of the conjunctiva. They are generally small in size and pedicellated. They are readily and easily removed by snipping them off with the scissors.

Pinguecula is a small, yellowish, elevation, occurring in adult life on the ocular conjunctiva, between the cornea and the inner canthus, and presents the appearance of an aggrega-

tion of fat cells, but really consists of hypertrophied connective tissue, elastic fibres and epithelial cells. It is innocuous and can be removed, if desired, by excising with a pair of scissors.

Warts and Dermoid Growths sometimes found upon the conjunctiva are usually congenital, and should be removed.

Pigment Deposits sometimes occur and may be associated with malignant growths. One case, I have seen, was cleared up by Sepia.

Cysts of the conjunctiva appear with moderate frequency, and usually after trachoma. They are translucent and generally require only incision of the sac for removal of the contents.

Epithelioma and Sarcoma are very rare except by extension from the globe or lids. When occurring independently, they should be removed. Ars. and Lapis alb. have been reported as producing improvement.

Lupus and Syphilitic Ulceration are also rare except by extension, and require no different treatment from that already considered in similar affections of the lid.

Encanthus is a congenital hypertrophy of the semi-lunar folds and may be associated with epicanthus.

CHAPTER XI.

DISEASES OF THE CORNEA.

ANATOMY.

Since the entrance of light into the eye depends upon the transparency of the cornea, the diseases which affect it become of the utmost importance from their general tendency to lessen its clearness. A thorough knowledge of the complex structure of this membrane is necessary for a full understanding of its diseases and their rational treatment.

The cornea forms an oval, with its longest diameter horizontal; it is 1.2 mm. thick at its insertion into the sclera and about 1 mm. at the center; while thus presenting but slight thickness, its tissue is very tough and capable of resisting considerable direct pressure without danger of injury. It presents five layers for examination (Fig. 91): 1, the anterior epithelial; 2, anterior elastic membrane (Bowman's); 3, the true corneal tissue; 4, a posterior elastic membrane (Descemet's); and 5, a posterior endothelial layer

The anterior epithelium is continuous with that of the conjunctiva of the bulb and consists of several layers, principally an external layer of flat cells, and a middle layer of dentated cells, which overlie a layer of club-shaped cells. These are all held together by a cement substance.

The anterior elastic, or Bowman's membrane, upon which these latter cells rest, is a fine, minutely fibrous tissue which gives to the cornea its lustrous appearance, but hardly deserves

the name of membrane, as it appears to consist mainly of cement substance holding fibrillæ and fasiculi which can be traced into the true corneal tissue which underlies it, and from which it is inseparable. This also passes over into the conjunctival tissue together with the first lamella of the cornea.

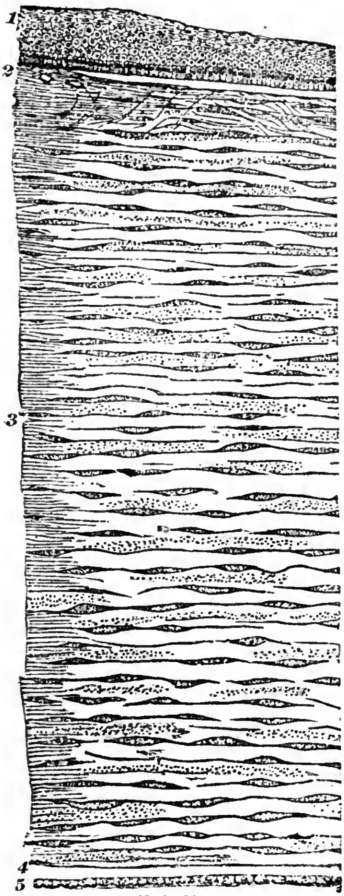


FIG. 91.

The true corneal tissue, which forms the greater bulk of the cornea, is made up of from sixty to seventy alternating laminæ which are arranged parallel to the surface of the cornea. The fibres of which the lamellæ are composed are nearly straight, have a definite direction in each layer, and cross each other at right angles in the alternate layers. These lamellæ are not separable individually owing to fibrillar binding connections between them. Each lamella is made up of numerous bundles of fibrillæ of connective tissue intersecting each other at various angles and united by cement substance. A number of these form a fascicle or bundle, and a number of these together form a lamella. In this portion of the cornea is found a complex system of minute canals which freely anastomose with each other and expand into lenticular shaped spaces or lacunæ; in the latter are found the true corneal corpuscles, which consist of masses of protoplasm containing a large nucleus and branching processes which partially fill the lacunæ and extend somewhat out into the canaliculi. Other varieties of cells appear in the cornea, some which seem to be portions of the fixed

cells, and others wandering or migratory cells similar to white blood corpuscles, and at the margin of the cornea are found pigment cells identical with those of the sclera.

This system of canals carries the nutritive fluid from the periphery towards the centre of the cornea, the corneal tissue being formed from the migratory and fixed cells. The corneal tissue with its canals passes over into the sclera. The true corneal tissue is limited internally by the posterior elastic membrane, which is thicker than the anterior elastic membrane, and more separable from the overlying tissue than the latter. Upon this membrane rests a single layer of epithelial cells held together by cement substance. The posterior surface of the cornea extends further back than the anterior so that it is slightly overlapped by the sclera.

The membrane of Descemet is a firm, structureless, but very elastic membrane, which, at its circumference, breaks up into trabeculæ or fibres which are partly continued into the front of the iris forming the *ligamentum pectinatum iridis* and partly into the anterior portion of the choroid and sclera. That portion forming the ligamentum pectinatum is covered with endothelial cells. These cells, however, do not stretch across the intervals between the processes, but leave spaces of communication between the anterior chamber at this part (the angle of the iris), with the canal of Schlemm.

In a state of health the cornea is not provided with blood-vessels except at the circumference, where they form very fine capillary loops and accompany the nerves. No lymphatic vessels are discoverable and the lymph is undoubtedly carried on by the canal system of the cornea.

The nerves are very numerous and are derived from the ciliary, which enter the fore part of the sclerotic, and are from forty to forty-five in number. They become transparent soon after entering the cornea and form several plexuses, through its structure and immediately beneath the epithelium, from which branches pass forward to form a terminal plexus amongst the epithelial cells.

DISEASES OF THE CORNEA.

The cornea may be the seat of inflammatory action which results in infiltration of its structure, changes in its tissue, or, its destruction in whole or in part. These pathological changes may be superficial or deep, and consist chiefly of an infiltration of the cornea with serum, or white blood corpuscles, from the marginal vessels; and an increase of its cells due to proliferation, as in the diffuse form of keratitis; or, if superficial and circumscribed, it may be a phlyctenular inflammation. If these cells are aggregated in a circumscribed portion so that the nutrition of the underlying layers is interfered with, loss of substance occurs and a corneal ulcer results, or, if the surrounding tissue does not give way, an abscess is formed, and if the infiltration becomes so great that the nourishment cannot be carried on through its natural channels, the whole cornea may be destroyed by the suppurative process. In the process of repair the new tissue is not always as regular or as transparent as the other portions of the cornea, but is cicatricial, and constitutes an opacity.

KERATITIS PHLYCTENULARIS.

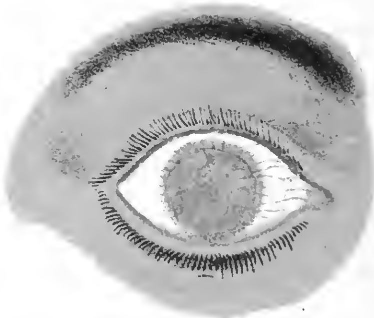
Herpes corneæ, Keratitis pustulosa or phlyctenularis (Plate III, Fig. 1) is one of the most common forms of corneal inflammation; it may occur in adult life but much more frequently appears during childhood. The particular feature of the disease is the occurrence on the cornea of papules, vesicles, or pustules, similar to those which characterize phlyctenular inflammation of the conjunctiva, and it is often simply an extension of that disease. When situated upon the margin of the cornea they are frequently small, and few in number, or numerous enough to encircle its periphery. When occurring upon the corneal surface they may be single or multiple, but there is always a bundle of minute vessels in the scleral conjunctiva which extends to the vesicle, and when a leash of vessels is developed in the cornea, as frequently happens in these cases, the term *fascicular keratitis* has been applied to

PLATE III

1

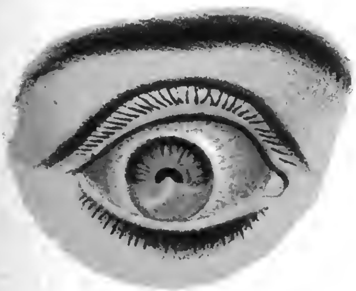
Phlyctenular Keratitis.

2



Diffuse Keratitis.

3



Hypopion Keratitis

4

Staphyloma Corneae

it. Again, if there are several of these vescicles the whole conjunctiva may be hyperæmic and present a catarrhal inflammation. The phlyctenules consist of minute elevations of the epithelial layer by serous infiltration, probably about the terminal filament of the sensory fibres of the fifth nerve. In from twenty-four to seventy-two hours, the epithelial covering ruptures and more or less corneal substance is lost, and a small ulceration occurs, accompanied with much photophobia from the exposure of the nerve filaments. If the case is a light one, the epithelium reforms in a few days leaving a small hazy portion at the point of attack. If the case is more severe, there is a greater loss of the cornea and the ulceration is deeper and may perforate, and the healing process proceeds more slowly and leaves a flattened surface or *facet* at the point, and a cloudy cicatrix or opacity remains. In some cases the whole cornea is seen covered with these small ulcers, and blood-vessels becoming developed through its superficial layers constitute a form of pannus. In bad subjects, one phlyctenule follows another, or successive crops appear, and the disease lasts for months.

Causes. — The disease results from mal-nutrition and improper hygienic surroundings, and hence is largely confined to the poorer classes. It occurs frequently and is very similar to phlyctenular inflammation of the conjunctiva. It occurs during dentition and at the age of puberty, and in children of a strumous habit, or who live almost exclusively upon a vegetable diet. In these cases, the disease becomes obstinate, frequent relapses occur, and the resulting opacities of the cornea interfere very greatly with the vision. It is often a sequela of measles, scarlet fever, and whooping-cough.

Symptoms. — The symptoms are very similar to those of phlyctenular inflammation of the conjunctiva, except more marked in degree, and there is usually considerably more pain. There is intense photophobia and the child will remain all day in a dark corner, or lie upon the bed with its face buried in the pillows during the day, endeavoring to exclude every ray of light. It cannot open the eyes, and if the

attempt is made to examine them, there is a severe blepharospasm, and a view of the cornea can only be obtained by the use of a retractor under the upper lid. The introduction of an elevator, or the attempted separation of the lids with the tip of the finger, is followed by a gush of tears and the cornea is rolled up out of sight, but if the lid is kept elevated it soon turns down, so that a view of the eyeball is obtained. It will then be found that one or more small points of ulceration are present on the cornea, or the latter may be very vascular and the eyeball injected. If the case is severe or has existed for a long time, the conjunctiva is found thickened and shows considerable muco-purulent discharge. The lids are thickened and on attempting to open them blood frequently comes from the fissures at the external canthus. In the majority of cases, there is a pustulous eruption on the parts about the eye which will give us a clue to the condition.

TREATMENT.—Attention must be given to the diet of the patient and it should be made as nutritious and as readily digestible as possible, the hygienic surroundings improved, and warm baths daily advised. The eyes should be protected from the light by a deep shade, or dark glasses, or a very loose bandage. The blepharospasm may be temporarily relieved, and the photophobia lessened by the use of ice-cold compresses and the instillation of atropine three or four times a day. The careful selection of the remedy, according to the indications here given, or from those under phlyctenular conjunctivitis, with a proper observance of the hygienic and dietic part of the treatment will result in a prompt cure of these cases without the use of topical applications.

Arsenicum.—Pustules appearing after measles; conjunctiva very red, photophobia, lachrymation, and thin, burning excoriating discharge; the lids may be puffy or œdematous and the children are often anæmic.

Calc. carb.—Large phlyctenules upon the cornea which have a tendency to spread and ulcerate. Photophobia is often intense and lachrymation profuse. The lids may be closed, red and swollen. The pains are more likely to be described as sticking.

Calc. iod.—When the tonsils and cervical glands are swollen.

Calc. sulph.—An extremely serviceable remedy when the cervical glands are enlarged. When administered in the lower potencies brilliant cures often follow.

Graphites.—Intense photophobia, so that the child cries from pain when exposed to light, and must be kept in a dark room. The lachrymation is often profuse, thin and acrid, and there is burning and aching in the eyes. The external canthi are fissured and bleed easily. There is often an eruption on the face or behind the ears. The nostril is frequently excoriated and discharges much mucus, or is covered with thick crusts. If this affection has existed for a long time the cornea may be vascular and pannus be present.

Hepar sulph.—Phlyctenules with intense photophobia, profuse lachrymation and great redness of the eyes. The pains are throbbing and relieved by covering the eye, and from warmth.

Mercurius sol.—Pustulous inflammation following measles or scarlet fever with severe pains which are continuous, and aggravated at night. The photophobia and lachrymation are variable. The lids are often spasmodically closed, thick, red and swollen, and excoriated from the acrid lachrymation.

Merc. nit.—This remedy has been used in all varieties of phlyctenular inflammation with marked success.

Pulsatilla.—Usually in cases where the pustules have extended from the conjunctiva. The symptoms are all mild and the photophobia may be entirely absent, and the pains not characteristic and not always present.

Rhus tox.—Small phlyctenules on the edge of the cornea, often forming a circle, with great photophobia and profuse lachrymation. Blepharospasm is commonly present, and the child lies constantly upon the face making every endeavor to exclude the light. The conjunctiva is very red, chemosed, and the lids swollen and spasmodically closed retaining a large amount of tears which are forced out on attempting to open them.

Sulphur.—The symptoms may vary greatly; the pains are

sharp and sticking in character, worse after midnight, and the photophobia is usually very great, the lachrymation may be very profuse or entirely absent. The characteristic eruption of Sulphur and the aggravation from bathing in cold water, are frequently present.

Among the other remedies which may be selected are Apis., Croton tig., Kali bich., Kali iod., Merc. prot., and Nux vomica.

KERATITIS ULCEROSA—CORNEAL ULCERS.

In this disease we have a softening and molecular death of a portion of the cornea from accummulation of the infiltrated cells at that point. Various forms of ulceration of the cornea are presented, and they are conveniently divided for clinical purposes into two classes, the *sthenic* and *asthenic*. Those of the sthenic type are accompanied by photophobia, pain, ciliary injection and lachrymation, and present usually a grayish base with perhaps swollen edges, or the infiltration extending beyond the limits of the ulcer. In the asthenic ulcer, there is little or no pain, photophobia or lachrymation. Either form may be superficial or deep. Two dangers are presented in ulcerations of the cornea, viz: changes in its transparency or opacities, and perforation of the cornea and involvement of the iris and the deeper tissues of the globe. Corneal ulcers may present an acute or chronic form; in the former the danger of perforation is greater, while in the latter, opacities are more likely to result.

Causes.—As the corneal tissue has no direct blood supply for the greater portion of its extent, its integrity suffers from any cause which interferes with its nutrition. This may occur from the want of proper nourishing elements in the blood, as in debilitated subjects, ill-nourished and scrofulous, or syphilitic children, or after prostrating diseases as typhoid fever, anæmia, and the exanthemata. Again its nutrition may be interfered with by other forms of keratitis, or violent inflammations of the conjunctiva, which obstruct the circulation of blood in the marginal loops of the cornea. The other forms

of ulceration arise from deficient innervation. A great majority are of traumatic origin, and injuries, even when very slight, may in weakened patients excite extensive ulceration.

SYMPTOMS.—The chief symptoms of ulceration of the cornea are photophobia, congestion and pain, which vary greatly in different cases. The photophobia is usually more severe in superficial than in deep ulcers, but its presence in any case should always lead to a careful examination of the cornea. The congestion consists of an injection of the vessels of the ciliary region and in some cases of the conjunctiva as well. The pain is also variable and is commonly referred to the parts around the eye rather than in the eye itself.

One of the simplest forms of corneal ulcers is that which occurs in phlyctenular inflammation. Another variety consists of a small grayish spot of infiltration which occurs at the centre of the cornea, which in the first stage shows a slight elevation, later, a depression, and the infiltration extends somewhat around the ulcer into the corneal tissue. The patients are young and poorly-fed children. The ulcer is slow to heal and generally leaves an opacity, or may spread and involve a large portion of the cornea in suppuration.

Another variety occurs in anæmic and strumous children with granular lids; one or more ulcers may appear and be attended with little infiltration, and after a chronic course, finally heal and leave a transparent depression or facet.

Superficial ulcers may appear without much, if any, infiltration and tend to extend over the greater portion of the surface of the cornea, while other forms may tend to involve the deeper layers rather than the superficial. Again, we find other forms of ulceration which, while perhaps not of great extent, show a most decided tendency to perforation.

The infiltration of the base of the ulcer is variable, or it may even be absent. The corneal tissue is sometimes thrown off without marked infiltration or congestion, as in the *chipping ulcers.* Again, the base may be grayish, white or even yellow, and the infiltration extend to a variable distance into the corneal tissue.

Some cases present a development of blood-vessels into the ulcer from the beginning, as in *vascular ulcers*, or when occurring later they may be an indication of repair, bringing an increased amount of nourishment to the part, and, as the ulcer heals, dwindle down and disappear.

One of the most severe forms of ulceration is the *serpiginous*, *crescentic*, *marginal*, or *ring ulcer*, of old and ill-nourished people, or occurring during the progress of a purulent conjunctivitis. When occurring in elderly people it is often slow in its progress, but cases are also presented where it is rapid and runs its course in one to two weeks. There is much photophobia, pain and congestion. A small excavation appears just within the corneal margin and soon extends until the centre is more or less completely surrounded by a furrow, which increases in depth, until the inclosed central portion of the cornea becomes infiltrated from its nutrition being cut off, and turns grayish, or yellow, and sloughs and the whole cornea is destroyed.

Complications.—In all forms as the ulceration extends deeper there is danger of perforation of the cornea. In the majority of cases the corneal tissue is destroyed until the membrane of Descemet is reached, which affords some resistance to further destruction and bulges forward from the pressure of the intra-ocular tension and presents as a small vesicle in the floor of the ulcer, or if the ulcer is of great extent, it may appear as if the process of repair had set in and the ulcer had become partially filled. In all cases the condition should be examined by focal illumination which will reveal the bulging of Descemet's membrane as well as the depth and extent of the ulceration. If there is no interference in these cases the membrane ruptures and the contents of the aqueous chamber are discharged, and the iris and the lens move forward. If the opening is large the iris protrudes through the aperture, forming what is termed a *prolapse of the iris.* The protruded portion appears as a brownish nodule surrounded by the grayish or yellowish margin of the ulcer. If the lens comes in contact with the internal opening in the cornea, a

partial capsular, or pyramidal cataract, results. As the ulceration heals, the iris may be freed by the establishment of the anterior chamber or becomes caught in the cicatrix.

Again, in some cases, the opening made by the ulcer becomes lined by the endothelium from Descemet's membrane and exists as a *corneal fistula;* in this case a minute drop of aqueous may be seen oozing through, when pressure is made upon the globe, and the depth of the anterior chamber is found diminished and the iris drawn forward towards the opening.

Hypopyon, (Plate III, Fig. 3), or a collection of pus in the anterior chamber is a complication of ulceration when the latter arises from, or takes on, a suppurative form.

TREATMENT.—Ulcers arising during the inflammatory affections of the conjunctiva, or cornea, require that the original affection should be allayed by proper treatment. The general condition of the patient must always receive attention. In all cases of ulceration of the cornea, atropine solution is indicated and should be applied frequently enough to cause a full dilatation of the pupil. Atropine is particularly indicated if the ulcer is central and sthenic. If peripheral and asthenic an eserine solution is more suitable. As the discharge from the conjunctiva or ulcer is often septic and irritating, the use of a solution of boracic acid (gr. x ad f℥i), or dilute chlorine water (1 to 3), dropped into the eye every hour or two, will aid materially the process of repair. If the ulcer is sthenic, rest in bed and cold applications, together with the use of atropine or eserine are necessary. A non-stimulating diet should be prescribed. If asthenic, hot fomentations or hot compresses should be used, atropine or eserine as before, and a generous and stimulating diet.

A pressure or retaining bandage will often prevent the extension of the ulceration, secure rest and hasten repair. If the floor of the ulcer is very thin it is better to avoid spontaneous rupture by opening the anterior chamber by the *operation of paracentesis corneæ,* which is made with a Desmarre's paracentesis knife (Fig. 92), or a broad needle (Fig. 93); the lids are held apart and the eyeball held by a pair of fixation

forceps, the knife is passed through the cornea near the sclero-corneal junction below, or at the outer side and independent of the seat of ulceration. After the knife has entered the anterior chamber, taking care to avoid wounding the iris or lens, or causing a prolapse of the iris, it is then slowly

FIG. 92.

FIG. 93.

withdrawn, slight pressure being made at the same time upon the lower margin of the wound. The operation is not very painful and may be done without ether. The wound may require opening daily with a fine probe until all danger is past.

Simple puncture of the floor of the ulcer by a fine needle may be sufficient, and the aqueous allowed to drain off slowly, care being taken to prevent wounding the iris or lens during the proceeding. This must be repeated as often as may be necessary to relieve the pressure. The patient must be confined to bed and atropine or eserine used, and a pressure bandage applied. Where the ulceration is deep or exhibits a suppurative tendency, *Saemish's operation* as proposed for the serpiginous ulcer may be used. The point of a narrow cata-

FIG. 94.

ract knife is introduced into the sound tissue on the temporal side of the ulcer, passed into the anterior chamber and then carried through the aqueous humor beneath the centre of the ulcer, and made to emerge in the sound corneal tissue on the other side of the ulcer. The knife is then made to cut its way through the cornea to prevent the sudden expulsion of the aqueous. Although the sensibility is not very great, it is permissible to use ether for the operation. The wound will have to be opened daily with a fine probe or Weber's probe-pointed lachrymal knife (Fig. 94).

After any of these surgical procedures atropine or eserine, as may be advisable, should be instilled and the pressure bandage applied.

When fistula of the cornea occurs or remains after the ulcerated process has passed, the opening may be closed by touching it lightly with a fine point of lunar caustic and a bandage applied, or the surface of the fistula abraded with a fine cataract needle. If these procedures fail, the application of poultices may produce sufficient stimulation to close it, or an iridectomy may have to be made.

The results of ulceration of the cornea are opacity, anterior synechia, prolapse of the iris, keratocele, and leucoma adherens or adhesion of the iris to the cicatrix.

REMEDIES.

Aconite.—Superficial ulcers arising from injuries. It may be used both internally and externally.

Arsenicum.—Corneal ulcers occurring in weak anæmic children. They are often superficial and have a tendency to recur. The photophobia is excessive and the lachrymation acrid and burning. The pains are more frequently burning and aggravated after midnight. Small grayish central ulcers which occur in young children and tend to perforate.

Aurum.—Vascular ulceration of the cornea and ulcerations occurring during the course of pannus, or as the result of abscess. There is much photophobia, profuse scalding lachrymation and sensitiveness of the eye to touch, and pains apparently extending from the parts around the eye to the eye, and aggravated by touch.

Calc. carb. and Calc. hyperphos.—Ulcerations occurring in ill-nourished patients which show a tendency to slough, or which result from abscess.

Conium. — Some superficial ulcers without much pain or redness but with intense photophobia.

Graphites.—In some cases of ulceration of the cornea which have followed attacks of phlyctenular inflammation of the cornea or conjunctiva.

Hepar sulphur. —A valuable remedy for all ulcers or abscesses where there is pus in the anterior chamber. There is usually a marked sloughing tendency and the pain is throbbing and the photophobia intense, while the conjunctiva is often red and thickened or chemosed. There is relief generally from bandaging the eye and the application of warm compresses, although there is great sensitiveness of the eye to touch.

Ignatia.—Small chipping ulcers without much discomfort, which occur in connection with derangements of the digestion; also small pinhole ulcers which are attended by photophobia and sensation as if something was in the eye, in nervous and hysterical patients.

Mercurius.—Often indicated in both superficial and deep ulcerations. There is generally grayish infiltration of the base and around the ulcer which is also often vascular. The discharges from the eye are profuse, thin and excoriating. There is a general aggravation at night. Concomitant symptoms more frequently decide upon the particular form of Mercury to be administered; the eye symptoms indicating Merc. cor. being more intense and there is much ciliary injection and pain.

Merc. nit.—More useful in those ulcerations which partake of a phlyctenular character.

Merc. prot.—Ulcerations occurring with pannus; its efficacy in *ulcus serpens* is very doubtful and it has not proved as useful as Calc. phos. or Silicia in these cases.

Nux Vomica and *Pulsatilla* suit some cases of superficial ulceration with intense photophobia, and it becomes very difficult to differentiate between them when marked concomitant symptoms are not present.

Silicia.—Indicated in some cases of sloughing ulcers of the cornea, as in the marginal ulcer, and when small, funnel-shaped non-vascular ulcers appear near the centre of the cornea and rapidly perforate.

Sulphur.—When the ulceration is indolent and tends to slough this remedy will be useful. There is often considerable infiltration around the ulcer but no vascularity. The photo-

phobia, lachrymation and other symptoms are variable. The sharp sticking pains which are commonly present and worse after midnight are very characteristic. The subjects are strumous and the general condition is indicative of Sulphur.

Many other remedies may have to be consulted for individual cases.

KERATITIS DIFFUSA.

Parenchymatous or Interstitial Keratitis (Plate III, Fig. 2) is the result of an infiltration of the corneal tissue from a proliferation of the corneal cells without changes in the epithelium or anterior elastic membrane. Both eyes are usually affected, but an interval of several weeks, or months, generally exists between the onset of the disease in the two eyes, the second being perhaps attacked while the first is recovering. The disease runs a protracted and tedious course extending over six or twelve months, but as the cornea rarely ulcerates the infiltration gradually disappears and leaves the cornea clear, and if the iris or choroid have not been implicated slight or no permanent damage is done. Two forms are to be considered, one characterized by dense infiltration without development of vessels in the cornea and the other presenting a general vascular condition of the cornea. They are both local manifestations of a constitutional derangement of the system.

DIFFUSE NON-VASCULAR KERATITIS.

Symptoms.—The non-vascular form begins with a haziness of the cornea which may be central or marginal. This cloudiness becomes more opaque and advances slowly over the cornea until the whole surface is covered and presents a steamy or ground-glass appearance, having lost its transparency and lustre, and hides the iris from view. This opacity will vary with different cases in different portions of the cornea from a slight haziness to a dense white opacity, or present more dense spots in some points than in others. Occasionally yellow spots are seen. When the inflammation has reached its height the

corneal epithelium presents a stippled appearance as if pricked with a needle. With the beginning of the infiltration there is slight photophobia which may be more marked later, or disappear. There is slight ciliary injection which increases as the disease progresses, or upon exposure to light during examination, or from irritation. The conjunctiva is scarcely affected and there is usually slight lachrymation. Pain may be entirely absent except by exposure of the eye to light or if the iris becomes implicated.

Causes.—The most common cause is hereditary syphilis. It appears during the ages of six and fifteen, sometimes as early as three; rarely later than twenty. When occurring in adult life it may be the result of acquired syphilis, and occurs with the secondary symptoms, or in women it may be occasioned by some uterine disease. No assignable cause can be found for it in other cases. When the disease appears in children, other symptoms of constitutional syphilis will be present in the child or mother. The child may present, per-

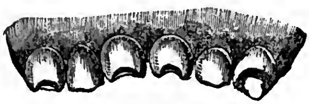


FIG. 95.

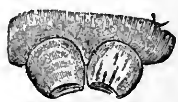


FIG. 96.

haps, evidences of a former iritis or some of the well-known signs of inherited syphilis in the teeth, skin, bones or physiognomy. The most distinctive of these are the notched teeth of Hutchinson as shown in Figs. 95 and 96. The evidence of congenital syphilis, as exhibited by the teeth, consists in a crescentic notch in the lower margin of the central incisors of the permanent teeth, giving them a chisel-like appearance, while the later incisors and canines are often peg-shaped and irregularly placed in the jaw. This condition of the teeth should not be mistaken for the serrated margins of the permanent teeth, which are more frequently found in children who have suffered from prostrating diseases during the early periods of the development of the teeth of second dentition. The skin in these patients often presents a peculiar yellowish

or earthy color and is loose and soft, and if the protuberant, square forehead, or broad, flattened nose bridge, and diseased condition of the bones occur, the evidences of inherited syphilis are complete.

TREATMENT.—No local treatment is necessary beyond the use of a solution of atropine if there is much pain or iritic complication. The duration of the disease is much shortened by the proper homœopathic remedy and a nutritious diet.

REMEDIES.

Aurum mur.—This preparation is the one most frequently indicated in these cases of syphilitic keratitis. The symptoms are those of diffuse infiltration with moderate photophobia, and pain which is of a dull character and referred to the parts about the eye.

Mercurius sol.—The inflammation is more active; there is usually more pain, greater ciliary injection and nocturnal aggravation than under Aurum, and the general concomitants of Mercury are present.

Mercurius prot.—Often useful when Merc. sol. does not act promptly.

Arsenicum.—Diffuse keratitis with marginal vascularity. The photophobia is intense, the lachrymation profuse, and burning pains are complained of. The aggravation after midnight, restlessness and thirst are commonly present.

Apis mel.—With the infiltration of the cornea there is moderate injection of the ciliary region and photophobia. Febrile disturbance, thirstlessness, and drowsiness often accompanying the condition.

Hepar sulphur.—Often serviceable when there is much ciliary injection or pain, great photophobia, lachrymation and sensitiveness of the eye to touch.

Baryta iod.—When enlargement of the cervical glands, which are hard and painful on pressure, accompany the diseases of the cornea.

Kali mur.—Interstitial keratitis with occasional pain, moderate photophobia and redness.

Sepia.—Diffuse keratitis, occurring in women suffering from uterine diseases.

DIFFUSE VASCULAR KERATITIS.

The vascular form begins as in the first variety; the cornea becomes infiltrated and hazy, but soon numerous small vessels are developed through it. They give to the cornea the appearance of spots of effused blood, or when the number of vessels is still more increased, the cornea assumes a dull red or fleshy appearance. The epithelium is loosened in some cases, but ulceration rarely follows. It occurs more often between the ages of ten and twenty years. Its course and duration are about the same as the non-vascular form. The photophobia, injection and pain are rarely more severe than in the simple diffuse form of keratitis, and as the disease progresses, the vessels disappear and the cornea again becomes clear, though small spots of infiltration and a clouding of the cornea may present for a long time. The disease is liable to be mistaken for pannus, but the smoothness of the cornea and the absence of a granular condition of the conjunctiva of the lids will prevent an error of diagnosis.

Causes.—The causes are virtually the same as those of the non-vascular form, and will appear in patients presenting evidences of congenital syphilis. This variety occurs much more frequently in strumous children presenting granular enlargement, and in girls at the age of puberty.

Treatment.—This is the same as that of the diffuse form, and of the remedies already considered in that condition, Aurum, Arsenicum, Baryta iod. and Hepar are more likely to be indicated; in addition to these, Cannabis sat. and Calc. phos. may be called for. After the inflammatory symptoms of either form have subsided Hepar s., Calc., Aurum mur. and Sulphur will be useful to clear up the opacities remaining.

Pannus or Superficial Vascular Keratitis occurs when the epithelial layer of the cornea is irritated, blood-vessels being developed in the epithelial layer from the capillary loops at its periphery. It occurs as a result of the irritation

of the granular deposits in trachoma or from the inversion of the cilia. It also appears in severe cases of phlyctenular keratitis. It differs from the disease just described, in that the vessels are well defined and distinct, and the corneal opacity is more dense. It begins on the upper portion of the cornea beneath the upper lid.

When pannus exists for a long time it may lead to softening and bulging of the corneal tissue.

Treatment.—Pannus disappears when the cause of the irritation has been removed, and its treatment has already been considered under trachoma and phlyctenular keratitis.

KERATITIS SUPPURATIVA.

Abscess of the cornea is characterized by a more or less local infiltration of pus cells to such an extent that a part or the whole of its structure is destroyed. The anterior layers of the cornea may break down and ulceration occur, or if the underlying layers are destroyed, the pus is evacuated into the anterior chamber and *hypopyon* results, or again, the pus may cause a separation of the lamellæ of the cornea and sinks down to the lower portion forming an *onyx*. The infiltration may begin at one point, either central or peripheral, and show a yellowish spot or abscess, or may begin at the periphery and extend around the cornea forming a *circular* or *ring abscess*, and later the whole cornea becomes infiltrated and sloughs. The process may stop at any point and repair take place. Opacity is likely to remain from the destruction of the corneal tissue and its repair by less transparent material.

Two varieties of the disease, *acute* and *sub-acute*, are described, but they present no distinctive clinical features as the symptoms of each form vary much. The *acute* variety is of a more sthenic character, with severe congestion, pain and photophobia; while in the *sub-acute* forms there may be almost entire absence of acute inflammatory symptoms, pain and photophobia, but the disease progresses rapidly to the complete destruction of the cornea.

CAUSES.—The acute form generally occurs in feeble constitutions as a result of injury, operations upon the cornea as in cataract extraction, cold and severe inflammation of the conjunctiva, as in ophthalmia neonatorum and other varieties of purulent conjunctivitis. The sub-acute form affects persons who exhibit a low condition of the system, due to want of nourishment, or is the result of debilitating diseases as variola, phthisis, typhus, or cholera, and in delicate, weak, children who do not receive proper nourishment.

SYMPTOMS, DIAGNOSIS AND PROGNOSIS.—In the acute variety, there is violent and severe pain which is referred to the eyebrow and temple, photophobia, lachrymation and ciliary injection, with perhaps chemosis and blepharospasm. The cornea is hazy and some portions present a grayish infiltration which soon becomes yellow at some point. The pus may escape externally and an ulcer form, or open into the anterior chamber, or gravitate between the corneal layers. If the pus does not find an exit the whole cornea becomes involved in the purulent infiltration.

In mild cases under proper treatment the disease disappears, leaving behind only a slight corneal opacity; in more severe cases the hypopyon and iritis increase, the ulceration spreads and perforation of the cornea may take place, and a large permanent cicatrix, with perhaps adhesions of the iris, occurs, and the suppurative process involves the whole eyeball. The course of the disease depends upon the amount of tissue involved and whether ulceration or hypopyon follows. The iris is apt to be involved and iritis results which increases the danger.

In the sub-acute form there is no marked symptom of inflammation, and the pain and photophobia are slight or absent. The prognosis depends upon the amount of cornea involved and its situation; if superficial, ulceration occurs, if more deep, the inflammatory process extends to the iris and choroid, the conjunctiva becomes congested and the destruction of the cornea progresses still more rapidly. The prognosis then is generally unfavorable, but depends upon the seat, depth and extent of the suppurative process.

TREATMENT.—Attention to diet is necessary and often a generous or stimulating diet may be demanded. In slight cases rest, the use of atropine locally and a pressure bandage, together with the use of Hepar s., Calc phos., or Sulphur is all that is necessary, the pressure bandage being contra-indicated in violent inflammatory forms with profuse conjunctival secretion. In the acute form, cold applications may be used locally if pleasant to the patient, and in the sub-acute variety when it arises from conjunctival inflammation, but if the cold applications are not comfortable, hot applications should be used. Hot fomentations, by means of light compresses soaked in water as hot as can be borne, are to be applied for ten or fifteen minutes at a time, every two hours, until improvement is perceptible, when the applications must be made at longer intervals. If the abscess shows no signs of absorption, it may be opened with the point of a cataract knife, but this is rarely necessary under homœopathic treatment. If ulceration occurs, it is to be treated as already described. If hypopyon results, the use of eserine may be indicated, or paracentesis of the cornea may be necessary. Perforation of the cornea is to be prevented by the means advised in the treatment of corneal ulcers.

The remedies useful in this form of corneal trouble are Hepar sulph., Calc. carb., Calc. hyperphos., Merc sol., Silic., and Sulphur, according to the indications given.

Hepar sulph.—Abscess and sloughing, or sloughing ulcers, of the cornea, when accompanied by hypopyon. Photophobia intense, lachrymation profuse, and there is great redness of the cornea and conjunctiva, with severe aching, throbbing pains; relief from warm applications, and aggravation from colds. There is marked sensitiveness of the eye to touch.

Calc. carb.—Cases occurring in children with the concomitant indications of calcarea. The pains, redness and photophobia are variable.

Calc. hyperphos.—In weak, debilitated individuals where there is great purulent infiltration and tendency to sloughing.

Calc. sulph.—Very useful in many cases of purulent infiltration of the cornea occurring in debilitated subjects.

Merc. sol.—In abscess of the cornea when there is a grayish infiltration extending some distance beyond the abscess. The conjunctival redness and photophobia are marked, while the lachrymation may be profuse and acrid. There is aggravation of the condition at night and from either very cold or very warm applications.

Silicia.—Abscess of the cornea with hypopyon. The pain, photophobia and redness are not characteristic. There is, generally, relief from wrapping the head or bandaging the eye.

Sulphur.—Not infrequently indicated in suppurative inflammation of the cornea in strumous constitutions. The sharp sticking pains of the eyeball, which occur more often after midnight, are very characteristic.

Neuroparalytic Keratitis is a somewhat rare disease which occurs in consequence of wounds or injuries of the superficial branches of the fifth nerve, or paralysis of the nerve itself due to intra-cranial causes. There is loss of sensibility of the cornea, the conjunctiva becomes dry, and the cornea cloudy, infiltrated, and is rapidly destroyed. The intra-ocular tension is lessened. In some cases the presence of a foreign body in the folds of the conjunctiva, or slight injuries of the cornea, seem adequate to produce sufficient innervation in debilitated subjects to impair the nutrition of the cornea.

Treatment.—The removal of the cause and the application of a bandage will, in slight cases, suffice to cause a return to the normal condition. In any case, the eye should be protected from external irritation by the closure of the lids and the same treatment used as in other forms of corneal suppuration. In addition the use of the constant galvanic current will prove of value.

Keratitis Punctata or *Descemetitis* is a term given to the dotted opacities which occur upon the membrane of Descemet. It is almost always the result of disease of the iris or ciliary body. When originating in the cornea, there is usually slight pain or considerable ciliary injection, with dimness of the vision from the changes of the endothelium. The punctated appearance takes a triangular form with the apex towards the

centre of the cornea. The disease is apt to be protracted and tedious.

Treatment.—Gelsem. and Kali bich. and the use of atropine are sufficient to clear up the condition in the majority of cases. Those cases occurring during the progress of iritis and cyclitis will be considered in the chapter devoted to these diseases.

CORNEAL OPACITIES.

Every possible variety of opacity as regards extent and density occur as the result of inflammatory changes in the cornea. Slight opacities, due to the healing of superficial ulcers are called *nebulæ* or *maculæ;* when they occur in very young children they may disappear entirely. Dense white opacities, *leucomata*, occur as a result of deep ulcers. Even these, in children, may clear up considerably in time. If the entire cornea is opaque the condition is known as *leucoma totalis*. If the iris is adherent to the cicatricial tissue, it forms a *leucoma adherens.*

The effect upon the vision depends largely upon its situation and density. If central, even the most delicate clouding is very destructive to vision, while very dense opacities, if the centre be clear, do not interfere materially with the vision.

These opacities are not infrequently productive of squint, and also cause a blemish which the patient is always anxious to have removed.

Improvement in the condition may be expected as long as the inflammation which caused the opacity continues, but no improvement is likely to take place after that has disappeared.

TREATMENT.—The internal administration of Calcarea, Aurum, Hepar, Cannabis, and Silicia, will oftentimes cause a very rapid and wonderful improvement in the transparency of these cicatricial spots. The application of some stimulant directly to the opaque portion is usually indicated where there is no vascularity of the cornea remaining. For this purpose a great variety of solid and liquid irritants have been used. Almost anything which will produce a slight irritation of the cornea which lasts for fifteen or twenty minutes will be useful.

The following have proved very useful when applied directly to the opacity: sulphate of soda, kali bich., calomel, sulphate of copper and aluminate of copper. Recently, I have had most excellent results from the application of Resorcin, in powder, to the opacity.

Stenopaic glasses by lessening the irregular refraction of light may be beneficial, but are rarely worn. If a clear portion of the cornea remains, then an iridectomy by making a new pupil will materially improve vision. Finally, an opacity of the cornea which is white and conspicuous may be tattooed with india ink, by means of a small bundle of fine needles as in Fig. 97. The lids should be held apart by the speculum, and the cornea dried by absorbent cotton which is also used to prevent the washing away of the ink, which is pricked into the substance of the cornea by the needles. A fine-pointed steel pen is often more efficient than the needles. Several sittings will usually be required. The irritation following the introduction of the ink is usually not very great. The ink is absorbed after a time and the tattooing will have to be repeated.

FIG. 97.

Ribbon-shaped opacity is a faint hazy opacity which crosses the cornea transversely in the horizontal meridian. It progresses very slowly and is supposedly due to deposits of calcareous salt in the cornea. It occurs in old people and accompanies other degenerative changes in the eye or may be the forerunner of a glaucomatous condition.

Lead deposits are dense white opacities which result from the use of lead washes in the treatment of eye affections when there is corneal ulceration. They may be removed as far as possible by carefully scraping them off with a knife, when the remaining opacity will gradually clear up.

Arcus senilis is an opacity which appears after middle life. It is confined to the margin of the cornea and is due to fatty degeneration of the corneal tissue; it occurs in the upper,

afterwards in the lower portion, and then encircles the cornea. There is a transparent portion between the opacity and the corneal margin.

STAPHYLOMA CORNEÆ (Plate III, Fig. 4) is a protrusion of the cornea caused by the pressure of the intra-ocular fluids during the process of healing which follows suppurative inflammation of the cornea while the tissue is soft and yielding, and occurs more frequently in children. It may be prevented, to some extent, by the use of Calc. phos. internally and the frequent puncture of the protruded portion, thus lessening the tension, until the cicatricial tissue has become more resistant. A large iridectomy may prove beneficial in arresting the staphyloma. When it has become total the vision is lost and the choice lies between the removal of the whole eyeball or its anterior part only, and removal of the contents of the eye. The latter operation leaves a better stump for an artificial eye, and the danger of any sympathetic trouble is not very great in this case.

The *operation for evacuation of the eyeball* is made in the following manner: The patient is put under the influence of ether and the eyelids separated by a speculum. The ciliary region is then transfixed by a Beers knife held parallel to the front of the eye and the anterior portion completely removed; the interior structures are then entirely removed by wiping them out with small balls of charpie which are held by forceps, until nothing remains but the scleral envelope. The conjunctiva at the outer anterior margin of the sclera may be brought together by two cross sutures and a light dressing applied. The reaction is apt to be great in some cases and may be prevented by the use of ice compresses for twenty-four hours. The stump is in a condition to wear an eye in about a month after the operation.

KERATO CORNUS or Conical Cornea (Fig. 98) is a conical protrusion of the cornea due to atrophy of the elements of the true corneal tissue, thus lessening the resistant power of this membrane.

The change comes on insidiously, the patient finding his

vision less distinct yet experiencing no pain, nor is there any particular injection. The increased convexity of the cornea may be scarcely noticeable, but as the disease progresses the apex of the cornea projects between the lids, and being no longer protected, becomes rough and finally opaque. The protrusion may cease, however, at any stage, and scarcely ever ruptures, as the corneal tissue becomes so thin at the apex that the aqueous filters through. It occurs usually between fifteen and twenty years of age and in delicate individuals. Both eyes are affected generally, but in different degrees. The vision is very greatly diminished owing to the abnormal curvatures and from the elongation of the axis of the eyeball, and there is slight improvement from concave glasses.

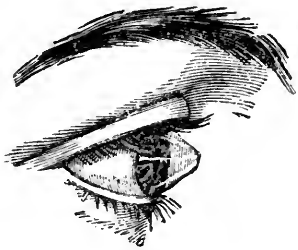


FIG. 98.

The diagnosis is easily made if the disease has progressed to any extent, as the conical shape of the cornea is easily seen when viewed in profile. All cases of rapidly progressing myopia with amblyopia should be carefully examined to determine whether it is due to the conical projection of the cornea.

Treatment.—Moderate degrees may be much benefited by the internal administration of Calc. iod. and Cannabis, and the constant instillation of atropine, together with the use of a pressure bandage when the disease is in a progressive stage.

If the progress is extremely slow, or has ceased, a careful study of the refraction and the use of combined cylindrical and spherical lenses may improve the vision. Lately it has been proposed to grind lenses with such parabolic curves as should give the best results in improving the vision. In extreme cases *Von Graefe's operation* may prove useful. This consists in shaving off the apex of the cornea until half its thickness is removed and allowing the wound to heal; the resulting cicatrix flattens the cornea somewhat, and an artificial pupil is then made by an iridectomy and the central scar tattooed.

The *operation of Bowman* consists in trephining the cornea with a small trephine which removes a circular disc from its centre and the wound treated in the same way as in Graefe's operation.

KERATO-GLOBUS is a general enlargement of the whole cornea and is a congenital condition, or may result from severe cases of pannus or vascular keratitis, which produces a softening of the corneal tissue which allows of its distention.

Treatment.—Little can be done to improve the condition of the patient beyond the application of a pressure bandage. The removal of a large section of the iris may be beneficial.

TUMORS OF THE CORNEA.

Tumors of the cornea occur very rarely. They are commonly dermoid tumors which arise from the corneal margin and involve both the cornea and sclera and are usually congenital. They are white or brown in color and small in size and may present hairs. They are readily removed by the knife.

EPITHELIOMA is a very rare affection and appears also at the corneal margin. Dr. T. F. Allen reports a case where the growth encircled the cornea which cleared up very markedly under the use of Hepar s. and Calc. carb.

MELANOMA and SARCOMA may appear at the corneal border and should be thoroughly removed as soon as possible.

CHAPTER XII.

DISEASES OF THE SCLERA.

ANATOMY.

The sclera, or sclerotic coat of the eye, is a strong, opaque, unyielding, fibrous structure, the outer surface being white and smooth except where the tendons of the ocular muscles are inserted. It is thinnest anteriorly about one-fourth of an inch from the cornea and thickest at the posterior portion where the sheaths of the optic nerve unite with it. The optic nerve pierces the sclera about one-tenth of an inch to the inner side of the axis of the eyeball, and the opening is somewhat smaller at the inner than at the outer surface of the coat.

The sclera consists of connective tissue fibres combined with fine elastic tissue, and amongst these lie connective tissue corpuscles lodged in cell spaces, similar to but not as regularly arranged as those in the cornea. The fibre bundles are disposed in layers both longitudinally and circularly, the longitudinal arrangement being most marked on the surface. These layers interlace and form a dense meshwork.

A few blood-vessels, in the form of capillaries with wide meshes, are distributed through its texture. Upon the surface of the sclerotic near the cornea, when this region is congested, are seen a number of vessels which are derived from the muscular and anterior ciliary arteries; they are not movable as are the overlying vessels of the conjunctiva. These sclerotic vessels dip in near the cornea and appear to unite with a

deeper capillary network disposed in closely set lines which radiate from the margin of the cornea, and are visible when the sclera becomes inflamed. At the anterior edge of the inner surface of the sclera a circular canal, the canal of Schlemm, lined by endothelial cells, gives passage to various plexuses of vessels from the sclera, and the ciliary veins, which communicate with the anterior chamber and the anterior ciliary veins.

In its anterior portion the sclera gives passage to the anterior ciliary arteries, veins and nerves; at the equator to the venæ vorticosæ from the choroid, and more posteriorly to the posterior ciliary arteries and nerves.

The sclerotic derives its blood supply from the anterior ciliary system and from the arteries about the optic nerve entrance which form a posterior vascular zone.

The presence of nerves in the sclera has not been satisfactorily demonstrated.

The inner surface of the sclera is grooved for the passage of the ciliary arteries and nerves and is brownish from the presence of pigment cells, and is closely connected to the choroid and ciliary body by the lamina fusca, the loose trabecular tissue over which are disposed endothelial cells and which forms the lymph space existing between the sclera and the choroid. The outer surface is somewhat rough and connected by loose connective tissue to the sheath of the globe, *tunica vaginalis* or Tenon's capsule, and anteriorly is connected to the conjunctiva by shorter filaments of subconjunctival tissue.

DISEASES OF THE SCLERA.

The sclera, owing to its very moderate blood supply and almost total absence of nerves is rarely the seat of acute inflammatory action, except from extension of diseased conditions of the cornea, iris, ciliary body and choroid. In the normal condition, the sclera appears of a bluish white color upon which are seen the blood-vessels of the overlying conjunctiva, at its anterior portion an anastomosing ring of vessels, the

scleral or *ciliary zone*, becomes apparent upon any inflammatory affection of the cornea, iris or ciliary body and constitutes an hyperæmia of the sclera. Inflammation of the sclera is characterized by the formation of new blood-vessels and infiltration of cells, which may result in thickening, or lead to softening with thinning and distention of its tissue.

SCLERITIS.

Inflammation of the sclera presents a dusky crescent of congested vessels usually upon the outer side of the cornea, or purplish spots appear upon the anterior portions of the sclera, more frequently about the insertion of the recti muscles where we have a greater blood supply. There is swelling of the portions of the sclera affected, with dull pain, lachrymation, and fatigue on use of the eyes. The margin of the cornea may be invaded and the sclero-corneal junction appears irregular and new tissue formations occur in the cornea. The inflammation is of a low type, and if it does not appear in the ciliary region, gradually extends to it, and involves the cornea.

Causes.—It is more commonly seen in women and appears to be connected with uterine irritation, suppressed menstruation and cessation of uterine functions. In men it is often associated with a rheumatic or gouty diathesis. In young people it seems to be dependent upon malarious causes. Some cases may be traced to a syphilitic taint, and a small gummy tumor may make its appearance in the sclera.

Symptoms.—Beyond the dusky appearance of the sclera at the point affected, the dull pain, and the absence of any discharge, there is little to call attention to the disease, as the vision is very rarely affected, and when the latter is disturbed, it arises from the extension of the inflammation to the choroid.

Prognosis.—The progress of scleritis is usually very slow, often lasting for months, and if the inflammatory process involves but a small portion of the sclera, the natural tendency of the affection is toward recovery. If the inflammation is extensive, or situated near the corneal margin, the sclera may

bulge forward changing the relation of the interior structures and thus injure the vision, or, as is not infrequently the case, the choroid or ciliary body become involved in the inflammatory process and the danger to the eye is thereby increased. Again, the cornea may suffer from ulceration, or opaque tissue be formed in its structure and encroach upon the pupil and thus interfere with the vision.

The disease shows a strong tendency to recur and the softened sclera yields to the intra-ocular pressure and staphyloma results. Occasionally there is a marked increase of the intra-ocular tension which may necessitate operative measures.

TREATMENT.—The local symptoms are very meagre and the general symptoms of the patient must be carefully considered in making our prescription. No local applications are admissible excepting the use of atropine, when the cornea or iris become involved. Among the internal remedies which may be called for in this disease are Ars., Merc. prot., Aurum mur., Thuja, Nux mosch., Silicia and Kalmia lat., in the order given. If there is much increase of tension an iridectomy may be necessary.

EPISCLERITIS is a term which formerly included all the forms of scleral inflammation, but should be confined to those partial inflammatory affections of the episcleral tissue which present appearances similar to scleritis. The tissue of the conjunctiva over the inflamed portion is hyperæmic, but there is no conjunctival discharge. The pain is often more severe than in scleritis, and the disease will exhibit the same tendency to recurrence, but is not as obstinate, and the attacks are much shorter.

Causes.—The cause is rarely determinable, but the condition occurs in rheumatic and gouty cases more frequently than in others.

Treatment.—In addition to the remedies noted for scleritis, Terebinth, Sulph. and Puls. may be indicated.

SCLEROTICO-CHOROIDITIS ANTERIOR or *anterior staphyloma of the sclera* may arise by the extension of the inflammatory softening or atrophic process of the cornea, or as the result of

choroiditis, scleritis, or intra-ocular tumors. The thinnest part becomes prominent and bluish and the internal parts of the eye are usually distended and atrophied. It may be partial or total. When the whole anterior portion of the eye is involved, the disease is called *Buphthalmus*; if the whole eyeball is affected it is called *Hydrophthalmus*.

The vision is usually lost from the implication of the nerve structures, and enucleation is often advisable. The condition may lead to a glaucomatous degeneration, or sympathetic inflammation of the other eye.

Causes.—Anterior staphyloma of the sclera may arise from an iritis which has involved the angle of the iris and the canal of Schlemm, or from irido-cyclitis, or incised wounds in the ciliary region.

Symptoms and Diagnosis.—The bulging of the sclera, in whole or in part, is unmistakable when present.

Treatment.—Nothing can be done for the condition when it has become once established, except to remove the eyeball if it becomes a source of irritation to the other, or when the projection of the sclera is such as to require relief for cosmetic purposes. Here enucleation will be necessary, unless the whole eyeball is involved, when evacuation of the contents of the globe as described under staphyloma corneæ will be better, as the great enlargement of the globe results in the absorption of the contents of the orbit to a considerable extent, and the removal of the whole eye under these circumstances does not leave sufficient cushion for an artificial eye to make it sufficiently prominent for cosmetic purposes.

Sclerotico-Choroiditis Posterior, or *posterior staphyloma* of the globe is much more frequent than that just described and is the productive cause of many cases of myopia. It usually occurs at the posterior pole on the temporal side of the optic nerve, and, with the ophthalmoscope, appears as a perfectly white spot from which the choroid has been retracted, and appears either as a crescent, or later, involves the whole of the sclera about the optic nerve entrance and forms an irregular ring.

Treatment.—The treatment consists in the use of those remedies which have already been considered when speaking of the secondary disturbance of myopia and the use of such hygienic measures as have been indicated in cases of progressive myopia.

CHAPTER XIII.

DISEASES OF THE IRIS.

ANATOMY.

The iris is the contractile and colored membrane which is seen behind the cornea and which gives the tint to the eye. In the centre of this movable curtain is a circular aperture, the pupil. The pupil is nearly circular in form and is placed a little to the nasal side of the centre of the iris. It varies in size according to the contraction or relaxation of its muscular fibres, this variation ranging from $\frac{1}{20}$ to $\frac{1}{3}$ of an inch, and regulates the amount of light admitted to the eyeball. The membrane of Decemet, on reaching the angle of the iris, *i. e.* the space in the anterior chamber bounded by the posterior margin of the cornea and the anterior surface of the iris, breaks up into fibrillæ of connective tissue, and these extend through half the breadth of the iris forming the *ligamentum pectinatum iridis*, or the supporting ligament of the iris. The endothelial cells of the posterior surface of the cornea are continued upon the trabeculated tissue at the angle of the iris and pass forward, becoming smaller and more granular, upon the anterior surface of the iris itself. The anterior surface of the iris presents numerous furrows which take a radial direction, except near the pupillary margin where they become circular. The tint of the iris results from an interference phenomenon of light, caused by its broken anterior surface, and from the brown pigment cells, which in dark eyes are

imbedded in the tissue of the iris. At its circumference we have the iris continuous with the ciliary body and choroid, the posterior surface being covered by a layer of dark pigment cells which is continuous with the *uvea*, the retinal layer of pigment which also covers the choroid and ciliary body. Between these two layers of cells, the epithelial anterior layer and the layer of pigment cells, just described, is the stroma of the iris, which consists of loose fibres of connective tissue, having a radial course towards the pupil, and a circular one at the circumference. These interweave with one another until a loose web is formed, which gives support to the pigment cells, which are branching and contain brown or yellow pigment. In this stroma we find the muscles, blood-vessels and nerves.

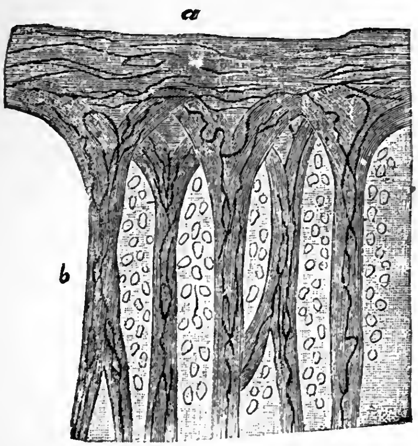


FIG. 99.

The muscular fibres are arranged in plates and are of the involuntary variety; one plate is disposed around the pupil (*a* Fig. 99) and is termed the sphincter, the other (*b* Fig. 99) appears as rays which come from the circumference and run towards the pupil. The sphincter muscle is a narrow, flat band of muscular fibres $\frac{1}{40}$ of an inch wide, on the posterior surface of the iris close to the pupilary margin. It is supplied by a branch of the third nerve. The dilator of the iris, the existence of which has been doubted, is a very thin layer of muscular fibres on the posterior surface of the iris stroma, covered and permeated by pigment cells. These radial fibres do not form a continuous muscle, but extend from the ciliary body in minute fascicles, which, as they approach the sphincter unite, forming arched plexuses which are partially lost in the sphincter.

Vessels and Nerves of the Iris.—The long ciliary arteries,

two in number, pierce the sclerotic a little in front and on each side of the optic nerve, and run through the loose tissue between the sclera and choroid directly forward to the ciliary muscle a short space behind the fixed margin of the iris. These vessels branch above and below and form a circular ring of arterial supply, which is augmented by the anterior ciliary arteries which branch from the arteries of the recti muscles. These anastomosing form the arterial ring, or *circulus major*, from which small branches supply the muscles whilst others converge towards the pupil and when near the margin, form another anastomosing circle, the *circulus minor*, from which capillaries are continued inward and end in small veins, which, increasing in size, follow the arrangement of the arteries and pass into the canal of Schlemm.

The nerves of the iris are derived from the ciliary nerve, which follows nearly the course of the blood-vessels, dividing into branches which communicate with one another as far as the pupil, there forming a close plexus of non-medullated fibres, whose ultimate termination is not known.

DISEASES OF THE IRIS.

Inflammatory diseases of the iris are very common and present several forms according to the nature of the inflammatory product, and are the frequent accompaniments of acute or chronic diseases affecting the conjunctiva, cornea, ciliary body and choroid.

IRITIS.

Inflammation of the Iris, or Iritis (Plate IV, Fig. 1), is characterized by an engorgement of the vessels, the exudation of serum into its tissue causing a swollen, spongy condition; the stroma cells become enlarged and their contents turbid, proliferation occurs and neoplastic growths result. Again, the product of the inflammatory action may be more plastic or lymph-like, the tissues become more swollen and stiff and the

PLATE IV

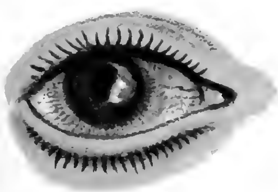
1

Iritis

2

Iritis, irregular pupil

3



Syphilitic Iritis (Condyloma)

4

Irido-Choroiditis

exudation collects upon the surface or fills the pupillary space with a membranous formation; or, it may consist entirely of pus cells, which are found to extend through the iris tissue and destroy it, or appear upon the surface of the iris or collect in the anterior chamber, forming an hypopyon. While all these pathological features may be present during any attack of iritis, yet in the inflammatory diseases of the iris each case presents a more or less well-defined form of exudation. Clinically, there is no special distinctive feature of the inflammatory process which enables us to determine the cause. It will be better then to divide the various forms according to their pathology into serous, plastic, and suppurative varieties.

Causes.—Iritis may occur at any age and from a great variety of causes. It appears more commonly between the ages of twenty to fifty years, and more frequently in men than women and generally one eye is affected, or one eye is attacked, and disease of the other follows. Recurrent attacks are not uncommon. The most frequent cause being syphilis, inherited or acquired; when occurring in very young children, it is often indicative of inherited syphilitic taint. It may precede or accompany secondary symptoms of acquired syphilis, being more commonly observed during the eruption of the roseola, or it may appear months or years after the primary disease. Injuries and operations upon the iris, or eyeball, and diseases of the cornea and conjunctiva, form the next most frequent causes. It frequently occurs idiopathically from sudden changes of the weather, exposure to wet or cold, particularly in ill-nourished and feeble persons, or in those exhibiting a rheumatic diathesis, and in patients suffering from gonorrhœa with, or without, gonorrhœal rheumatism. It may appear in young girls at puberty, or result from suppression of the menses. Finally, it forms a very important part of the dread disease, known as sympathetic ophthalmia.

Symptoms.—The surface of the iris loses its lustre and striated appearance, and its color becomes dull and changed from the congestion and effusion into its structures, together with the turbid condition of the aqueous which occurs from

the exudation. The iris does not respond promptly to the stimulus of light, owing to the increase in its volume; it may be immovable from the gluing of its posterior surface to the lens from the plastic nature of the exudation. The pupil appears dull and in many cases is contracted or filled with lymph. If the attack is severe a large quantity of lymph is thrown out and collects upon the pupillary margin in minute beads or covers the surface of the iris, or extends across the pupillary opening. The eyeball is congested, particularly in what is termed the ciliary zone, that portion of the sclera immediately behind the cornea, where a zone about one-fifth of an inch wide exhibits a pinkish injected appearance due to the development of straight radiating vessels, branches of the anterior ciliary arteries, which appear larger at the corneal margin and disappear after extending a short distance upon the sclera. This condition is, however, masked by the congestion of the overlying conjunctiva. Owing to the great vascularity of the iris and its plentiful supply of sensitive nerves, its inflammation is very marked and accompanied by severe pain due to pressure of the nerve filaments by the exudation. The pain is not limited to the eye, but extends over the supra-orbital region and to the sensitive fibres of the fifth nerve, and is variable and neuralgic in character, worse at night and after midnight. There is usually great intolerance of light, but this is a variable symptom and not as constant as in corneal affections. Lachrymation is often copious, but there is no discharge of mucus or pus as in conjunctival diseases. The vision is misty or is much diminished from the aqueous becoming turbid from the exudation mixing with it, or from the pupil becoming occluded with lymph. The tension of the eyeball is often slightly increased. There may be considerable febrile disturbance and a rise of one or two degrees in the temperature. There may be also a swollen œdematous condition of the lids, this being more frequently the accompaniment of iritis following operations upon the eye, as after cataract extraction when it is an early indication of the commencing inflammation. In the acute forms of iritis, all these symptoms

are very prominent, but in the more chronic varieties there is great variation; the impaired vision with discoloration of the iris and the presence of adhesions between the lens and the iris, may be the only symptoms present.

DIAGNOSIS.—From the symptoms thus fully given, there should be little difficulty in recognizing the disease. The condition of the pupil as to color and mobility, when compared with the well eye, is more diagnostic than the other symptoms, and the use of atropine causes a dilatation of the parts of the iris between the adhesions, or synechiæ, giving the pupil an irregular appearance (Plate IV, Fig. 2) when present, and is conclusive evidence of iritis, and enables a correct diagnosis to be made. In cases of iritis where the aqueous is cloudy the use of atropine clears up the anterior chamber, and gives a view of the iris while in keratitis when the cornea is hazy the condition is not changed.

In the early stages of iritis, or when the hyperæmia has involved the vessels of the conjunctiva, the diagnosis may be difficult, but the presence of marked pain and a sluggish condition of the pupil in iritis and the absence of the discharge and of severe pain, which is present in conjunctival affections, will generally be sufficient to differentiate between the two diseases, and in all cases of doubt, atropine should be used, and if there are any synechiæ, they will become observable at once. From neuralgic affections of the ciliary nerves, it will be differentiated by an absence of pain and inflammation present in the purely neuralgic affection; from cyclitis which may complicate the attack, it may be diagnosticated by the pain being more severe and the extreme sensitiveness of the ciliary region to touch in cyclitis.

COMPLICATIONS AND SEQUELÆ.—From the similarity of the structure and the common vascular supply of the iris, ciliary body and choroid, inflammation of the iris tends to involve these tissues. Diseases of the cornea or sclera often implicate the iris and thus render the situation more grave. The permanent results of iritis are adhesions to the lens capsule, or posterior synechiæ, and occlusion of the pupil by means of

organized exudation; the adhesions of the iris to the lens capsule may be slight, or extend over a greater portion of the surface, and thus interfere with the nutrition of the lens, and cause cataract. Defective sight is occasioned by these changes in the pupil or in the lens, and also by plastic exudation and pigment spots, which may be left on the capsule from the synechiæ, and if occurring in the pupil, or near its margin, cause the appearance of black spots in the visual field which prove very annoying to the patient.

Prognosis.—If early recognized and properly treated the result is almost always favorable. The attack may be so slight as to disappear in a few days, yet if neglected or improperly treated may rapidly destroy the eye, or continue for months and end in atrophy of the iris tissue, or of the whole eyeball. Mild cases usually last for two or three weeks, but the duration depends more upon the severity of the attack and its methodical treatment.

Treatment.—In every case of iritis, and whatever the cause may be, the first thing to be done is to use atropine to dilate the pupil, because it relieves the tension of the eyeball, prevents adhesions forming between the iris and the lens, or between the opposite margins of the pupil, which might otherwise become entirely blocked up with lymph. It also gives rest to the inflamed tissue and has a marked effect, in most cases, upon the severity of the pain. A drop of a four-grain solution of atropine is to be placed inside the lower lid, every half hour, until the whole iris, or such portions of it as are not bound down by adhesions, is fully dilated. Afterward a drop every two or three hours, or less, will be sufficient to keep up the impression made. If the pupil dilates fully and the atropine is kept up until all congestion has disappeared, the eye will recover without other treatment. If the adhesions of the iris are recent and not very extensive, the atropine will often tear them so that the pupil will again become regular, and further adhesions be prevented by keeping the pupil well dilated. If atropine is not well borne, which fortunately is rare, greater care must be exercised in instilling it into the

eye, and if much irritation or pain follows its use, or toxic effects appear, some other mydriatic, as duboisia, should be substituted. Homatropine is comparatively valueless in the treatment of inflammatory diseases of the iris.

All use of the eyes for near work must be forbidden, and the case will recover more quickly if confined to the house and, in severe cases, to the bed, where an equal temperature can be sustained, as all cases of iritis are quickly affected by changes in temperature or atmospheric influences. The eyes should be shaded from the light by darkening the chamber, or if the patient is allowed to be up and out, dark protective glasses or a shade, such as will fully protect the eyes, are to be worn. A bandage is rarely necessary. The diet will vary with the condition of the patient and is usually low, and all stimulants should be interdicted.

The pain, which is often very severe and prevents sleep, interferes with recovery and may be moderated by enveloping the affected side, or the whole head, in a layer of cotton batting secured by a nightcap or bandage. The attacks of pain which commonly occur during the night, demand the application of hot compresses, either of bags of hot bran or salt, or of flannels wet with hot water until the pain is modified or relieved. Where atropine seems to exert but little effect on the condition, and the pain is not controlled, the continuous application of flannels wet with a hot decoction of hops and chamomile flowers will often have a soothing effect and render the absorption of the atropine or duboisia more speedy. Cold applications are rarely indicated, except in the first stage of iritis following injuries or operations, when they may be prophylactic, but after the condition has become one of active inflammation, they should not be used. If the disease assumes a chronic form, or even if it be acute and obstinately resists all treatment, or whenever there is a marked increase of the tension of the eyeball, an iridectomy should be made, as this may shorten the attack. The incision should be made with a keratome, just behind the margin of the cornea and the segment of the iris removed close to its outer attachment. The iridectomy should

be made upward, so as to be concealed by the upper lid. If the adhesion of the iris to the lens is complete, or the pupil occluded, the immediate performance of an iridectomy is demanded as soon as the congestion has disappeared; the operation should in this case be made inward and a little downward, unless the pupil is clear, when it should be made upward. In these cases, it is often impossible to make a clear cut in the iris, owing to the impossibility of drawing the iris out, but the tissue tears easily and sufficient can generally be removed to gain a fair pupil. If the operation is too long deferred, the lens becomes cataractous and other changes in the tissues give but little chance of any improvement.

REMEDIES.

Under the following heads are indicated the remedies for the various forms of iritis.

Aconite.—In the first stage of an attack which appears after injuries to the iris. In other varieties arising from exposure to cold in which the inflammation appears sthenic from the inception of the attack.

Arnica.—Recommended for iritis arising from rheumatic and traumatic causes, but it is of doubtful utility.

Asafœtida.—In the plastic variety occurring particularly in females and from acquired syphilis. The pains are very characteristic and are described as of a throbbing, beating or burning character in the eye, and above, or around it, and lessened by rest and pressure, as of the face or side of the head in the pillow.

Aurum mur.—May be indicated in some cases of iritis occurring in syphilitic subjects where the pains are described as seated deep in the bones about the eye, and of a tearing, pressing, character and extend from above downward and from without inward. (The reverse of Asafœtida.)

Belladonna.—The choice between Aconite and Belladonna becomes necessary in the early stages of iritis, and will have to be made according to the concomitant symptoms. Under

Belladonna, there is usually marked photophobia and contraction of the pupil.

Bryonia.—More useful in the serous form of iritis, but is also indicated in the plastic when occurring in rheumatic patients. There is soreness and aching in the eyeball and orbit, and sharp, shooting pains which extend through the head or face, or pressure under the orbit as if the eye would be forced out may be complained of. The eyeballs are often sensitive to the touch and on motion.

China.—Indicated in iritis occurring in debilitated subjects, and with a marked periodicity, or when arising from malarious causes.

Clematis.—This remedy is to be strongly recommended for the various forms of iritis when accompanied by little pain and great sensitiveness to cold air. It has been claimed to have a marked absorbent action upon the synechiæ, but I have never been able to satisfy myself of its efficacy.

Gelsemium.—The most valuable remedy for the serous variety. The special eye symptoms in this variety of inflammation are not marked.

Hepar sulphur.—Serviceable in any variety of iritis, and particulary indicated in the suppurative form with accompanying hypopyon. The pains are usually throbbing and intense, with great sensitiveness of the eye to touch. Warm applications seem particularly pleasant.

Kali iod.—Very useful in either the plastic or serous forms, particularly from syphilitic causes.

Mercurius.—The value of the various forms of Mercury in the treatment of iritis, is, I believe, very much overestimated, although it has long been considered purely homœopathic. As a result of my own observations, I cannot agree with the homœopathic authorities in regard to its frequent indication in iritis. I am fully convinced of its homœopathicity in various conjunctival, corneal and retinal diseases, but in iritis no benefit is derived from its use, unless the lower triturations as the 1x, 2x and 3x are administered, and with such frequent repetition of the dose that an alterative effect is produced.

When administered in this way there is undoubtedly a marked effect produced upon the inflammation, in lessening the plastic exudation which is so marked, particularly in syphilitic cases. Its true homœopathic sphere seems to be in those cases of iritis which approach the serous variety, or when the plastic nature of the exudation is not marked. Here Merc. cor. in the higher dilutions has given extremely satisfactory results.

Nitric acid.—A valuable remedy in the chronic and recurrent varieties in syphilitic patients. The inflammatory symptoms are asthenic and the pain is often worse during the day than at night.

Rhus tox.—In plastic and suppurative iritis occurring after operations upon the eyeball, or plastic inflammation associated with a rheumatic diathesis; the symptoms are intense and accompanied by chemosis and swelling, and spasmodic closure of the lids.

Spigelia.—Very suitable to cases of mild iritis where the inflammatory symptoms are not marked yet accompanied by severe neuralgic pains in and around the eye.

Sulphur.—In the suppurative variety with hypopyon, or in the chronic form. The symptoms are variable and the prescription must be made upon the concomitant conditions.

Terebinth.—A very important remedy for the plastic variety when presented in rheumatic patients, with the urinary symptoms characteristic of the remedy.

Thuja.—In plastic iritis in syphilitic subjects where condylomata are developed in the tissue of the iris.

Among other remedies which may be useful in special cases are Pulsatilla, Cedron, Silicia, Cimicifuga and Prunus spinosa.

IRITIS SEROSA.

Serous iritis is a low form of inflammation in which the pupil is usually dilated. Minute flakes of lymph, and loosened epithelial cells from the surface of the iris, together with the serous product of the inflammation, accumulate in the anterior chamber and give to the aqueous a turbid appearance. There

is frequently also an extension of the inflammation to the membrane of Descemet (or descemetitis), with proliferation of its endothelial cells, and the appearance upon the inner surface of the cornea of minute, whitish, opaque spots, which form a ring opposite the pupil, or have a triangular shape with the apex upward as already described under keratitis punctata. From the increase of the contents of the anterior chamber the iris and lens are pushed backwards and the anterior chamber appears much deepened and the intra-ocular tension is often considerably increased. There is much less tendency to adhesion of the iris to the lens than in other forms of iritis.

Causes.—It is liable to occur either as a result of inflammation of the deeper tissues, as the ciliary body and choroid, or of sympathetic inflammation, or from any cause which produces general debility, as prolonged lactation and constitutional syphilis.

Symptoms and Diagnosis.—As already stated, there is usually a partial dilation of the pupil, the iris appears dull and is very slow in its response to light. The vision is poor from the cloudy condition of the aqueous; the pain is not marked, and the ciliary zone presents but slight injection. The eye, however, has an irritable appearance and flushes up easily under examination. Examination with focal illumination is often necessary to reveal the deposits of lymph on the surface of the cornea. There is no febrile reaction, which may be present in other forms of iritis, and there is so little general complaint that the affection may be neglected by the patient or overlooked by the physician. Occasionally, we may find it taking on a more active condition in cases which have previously had iritis and resulting adhesions. The disease is apt to be obstinate and very protracted and the prognosis is often doubtful.

Treatment.—Atropine or duboisia are indicated if there is any tendency to adhesions, or if the tension is not markedly increased. If there is much increase of tension the mydriatics will not be absorbed unless paracentesis is performed. The internal administration of such remedies as Gelsemium,

Arsen., Bryonia, Kali bi., Kali iod., will be indicated. Eserine solution externally if there are no adhesions will often cause a subsidence of the inflammation without operative measures, which consist in the performance of a large iridectomy in protracted cases.

IRITIS PLASTICA.

Plastic inflammation of the iris is the most common form of iritis and has already been described under the general head of iritis. It is characterized by the exudation of coagulable lymph into the structure of the iris and gives it a swollen appearance and collects upon the surface narrowing or occluding the pupil and gluing the posterior surface of the iris to the lens, so that adhesions occur over a greater or less extent of its surface, and on the administration of atropine the pupil does not dilate, or appears irregular as in Plate IV, Fig. 2. Adhesions occur early and there is a narrowing of the pupillary opening.

In some cases of plastic iritis occurring in syphilitic patients one or more small gummy tumors upon the iris (Plate IV, Fig. 3) are observed. These condylomata may be reddish in color or yellowish and are pathognomic of the syphilitic variety of iritis. These gummata grow rapidly and may destroy the eye, but usually respond readily to treatment and disappear and leave no trace.

The vision rapidly deteriorates in plastic iritis from the clouding of the aqueous or the occlusion of the pupil. There is often marked febrile excitement, severe pain, photophobia and lachrymation. If the ciliary body becomes involved, the eyeball becomes sensitive to touch especially over the ciliary region.

Treatment.—Atropine must be used as early as possible and the adhesions torn or the dilatable portions of the iris withdrawn as far as possible. The atropine should be applied every two or three hours until the inflammatory symptoms subside. If the mydriatic seems to lose its effect or produces no effect upon the pupil or the tension is increased, a para-

centesis of the cornea should be made, as the atropine will be more readily absorbed afterward and the operation itself will, if properly performed, have a marked influence in relieving the irritation of the eye; occasionally better results are obtained from duboisia. Hot applications are to be applied to mitigate the pain, and if the case is at all severe, confinement to bed is necessary.

It is well to envelop the head in a thick layer of cotton which should be worn constantly, and particularly at night, as it lessens the tendency to the nightly attacks of pain by keeping up an equable temperature of the parts about the eye.

The internal use of Asafœtida, Aurum, Bry., China, Clematis, Eserine, Merc. cor., Hepar s., Kali iod., Rhus tox., Sulphur or Terebinth, according to the indications already given, will produce rapid cures.

IRITIS SUPPURATIVA.

Purulent iritis may begin in the same manner as the plastic variety, but soon the pus which has permeated the iris tissue and produced marked changes in its color, finds its way into the anterior chamber, which perhaps it half fills, forming hypopyon, as in Plate III, Fig. 3. Adhesions may form as in the plastic variety and it presents no special distinctive symptoms from the latter. It is the most destructive form of iritic inflammation and is generally the result of injuries to the iris, ulcerated wounds of the cornea, or after operations on the eye, and is frequently the result of the extension of suppurative inflammation of the choroid.

Treatment.—Atropine must be used even when there seems to be no effect upon the pupil. Confinement to bed and the use of hot wet applications are necessary. As soon as hypopyon appears, unless the pus is absorbed and the condition improved by the remedies, a paracentesis should be made and the pus allowed to flow out through the opening, or if stringy and thick it may be necessary to extract it with a pair of fine iris forceps. The remedies most useful will be Hepar s., and Merc. cor.

Iritis spongiosa is a rare inflammation of the iris which is characterized by the filling of the anterior chamber with a sero-fibrinous exudation which has a delicate smoky or bluish appearance. The aqueous is turbid and the surface of the iris hidden by the exudation which may be soon absorbed or temporarily disappear on paracentesis of the cornea. It occurs after cataract extraction and in some cases of iritis occurring in aged people, but is a rare affection. In the only cases which have come under my notice, the condition rapidly cleared up under Kali bi. and Bryonia. The inflammatory symptoms seemed to be only of low degree; the pain, photophobia and other eye symptoms were not prominent.

TUMORS OF THE IRIS.

Morbid growths on the iris are very rare, but cases are presented occasionally which require treatment.

Sarcomata and Melanomata are very rare, and when occurring soon involve other tissues and require the removal of the eyeball.

Cysts are more common, although still very rare, and are developed in the iris tissue and gradually encroach upon the anterior chamber, or extend backward toward the ciliary body. They usually form very slowly and cause no disturbance until they increase considerably in size and then give rise to pain.

Treatment.—The best method of treatment consists in the excision of the portion of the iris which contains the cyst by an iridectomy.

Granuloma are small nodular masses of granulation tissue which are sometimes seen after operations upon the iris. They require no treatment.

CONGENITAL MALFORMATIONS.

Irideremia or absence of the iris is of extremely rare occurrence and is accompanied by other congenital defects.

Coloboma Iridis or cleft iris, occurs either in one eye or in both. The fissure is generally below but may be above. There is often a corresponding defect in the choroid.

Displaced Pupil.—Sometimes the pupil retains its rounded form, but is placed close to the margin instead of opposite the centre of the cornea. The condition is termed Ectopia.

Persistent Pupillary Membrane.—The remnants of the membrane which extend across the pupil in the fœtus sometimes persist after birth in the shape of fine threads extending across the pupil or upon the margin of the iris. They demand no operative interference.

FUNCTIONAL DISEASES OF THE IRIS.

Functional disturbances of the iris occur sympathetically with other diseases. In certain diseases, as apoplexy, there may be first a dilatation of the pupil followed by its contraction during the stage of reaction. In meningitis, however, the pupil is contracted in the first stage, while as the disease advances the pupil becomes dilated. In attacks of hysteria the pupil is first contracted and becomes dilated later. In spinal sclerosis, there is immobility of the pupil followed by wide dilation.

MYDRIASIS.

Mydriasis is a persistent dilation of the pupil and is readily diagnosed from the fact that the pupil does not contract on exposure to light. It is often associated with paralysis of the accommodation. Mydriasis is commonly confined to one eye but both may be affected. The dilation may be partial or complete. The dilation of the pupil results from paralysis of the branch of the third nerve which supplies the circular or sphincter muscle of the iris. The same effect may be produced by the irritation of the cervical branches of the sympathetic which are distributed to the dilator fibres. Large pupils occur in myopes because they do not use their accommodation and also in persons who are much debilitated, or suffering from anæmia, but in these cases the pupil is not inactive nor is the dilatation as great as in mydriasis.

CAUSES.—Mydriasis appears as the toxic effect of certain drugs as atropine, homatropine, hyoscyamine, duboisia, daturine, gelsemine and others. It is not infrequently a sequela of diphtheria and may precede or accompany other muscular paralyses from the same cause. Traumatic injuries, concussion of the brain, syphilis, meningitis, hydrocephalus, cerebral tumors, sudden checking of the perspiration, rheumatism, neurasthenia, exhaustion, intestinal irritation and loco-motor ataxia may all be exciting causes.

TREATMENT.—Those cases which respond to treatment are dependent upon diphtheritic or syphilitic causes. Here Gels., Bell., Physostig., Arg. nit., or Kali iod., will be among the indicated remedies.

In other cases but little benefit is derived from treatment, unless the more serious affection can be relieved. When associated with paralysis of the accommodation and of the ocular muscles, the remedies suggested for their treatment may relieve the mydriasis.

When occurring from the accidental instillation of atropine, it may be partially relieved by the use of pilocarpine or eserine externally.

MYOSIS.

Myosis or contraction of the pupil is the opposite of mydriasis and results from paralysis of the sympathetic, or irritation of the third nerve, and may accompany spasm of the accommodation.

CAUSES.—Contraction of the pupil occurs in poisoning from opium or its alkaloids, from instillations of eserine, pilocarpine and some other drugs. It is sometimes traumatic in its origin, as from injuries to the cornea or from the presence of foreign bodies. When the contraction is reflex from irritation of the fifth nerve, it is sometimes associated with atrophy of the optic nerve from cranial causes. It may arise from an over-sensitive condition or hyperæsthesia of the retina and from growths which cause pressure upon the cervical sympa-

thetic, and from lesions of the cervical portions of the spinal cord.

Treatment.—This must be directed to the cause of the disease.

Hippus is a rare affection in which there is a rapid dilation and contraction of the pupil. In the only case I have seen it was congenital and associated with a clonic contraction of the levator superioris and affected the right eye only. The spasmodic condition became very prominent on any excitement of the child.

Iridodonesis, or a tremulous condition of the iris, is dependent upon a fluid condition of the anterior part of the vitreous or from the loss of its natural support, the lens, and is seen after the extraction of the lens in its capsule for cataract, or when there is luxation of the lens into the vitreous.

OPERATIONS UPON THE IRIS.

Iridectomy.—This operation, which was brought into prominence by Von Graefe, is the most frequent operation upon the iris, and has a most decided influence in checking some destructive processes in the eye when accompanied by intra-ocular tension, as in glaucoma, cyclitis, or irido-choroiditis. It may be useful in chronic iritis especially when recurrent, or when there are extensive adhesions, and in some cases of keratitis, or, for the removal of foreign bodies in the anterior chamber or upon the iris or lens. It is also preliminary to cataract extraction, or is made for the formation of a new pupil in opacities of the cornea, or stationary opacities of the lens. In making an iridectomy the purposes for which it is done are to be considered. If it is for lessening the tension as in glaucomatous conditions of the eye, a large part of the iris is to be removed and the upper portion is to be selected in all cases where there is no contra-indication, as the upper lid then covers the deformity to a large extent. If it is preliminary to cataract extraction, it is to be made in the same direction as that of the incision for the removal of the lens.

When made for the purpose of improving the vision, the best situation is inward and downward if the corneal opacity and the other lesions will permit it; if not, then it should be made directly inward, downward or outward, as the condition may decide. The extent of the iris to be removed will depend

FIG. 100.

upon the indications for the operation; if made for therapeutical purposes, as in glaucoma, a large portion should be excised, perhaps one-fourth or one-third of the iris; if for improvement of the vision, then a small fissure may be sufficient, perhaps not more than one or two lines or 2 to 4 mm. The location of

FIG. 101.

the incision will also depend upon the indications for the operation; if for therapeutic purposes, it will be made in the sclero-corneal junction, while for optical purposes within the cornea. The instruments necessary are a speculum, to separate the lids, a pair of fixation forceps, a lance-shaped keratome, straight or

FIG. 102.

curved as in Figs. 100 and 101, or a linear cataract knife (Fig. 102), a pair of straight, or curved iris forceps (Fig. 103) and a pair of straight, or curved iris scissors (Figs. 104 and 105).

If it is desired to make a very broad iridectomy, or if the anterior chamber is shallow, a narrow cataract knife is more

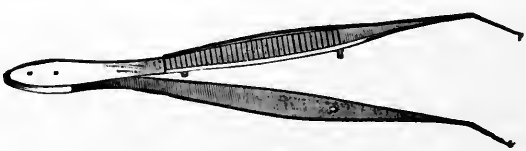


FIG 103.

suitable than a lance-shaped keratome. When a small portion of the iris is to be removed, a small lance-shaped keratome answers the purpose better. The operation is performed in

the following manner: An anæsthetic may be used or not according to the judgment of the surgeon. The patient is placed in a recumbent position and, if an anæsthetic is used, when the cornea is no longer sensible to the touch of the finger, a speculum with the blades closed is introduced between the lids and the latter widely separated. The eyeball is then steadied by seizing the conjunctiva with fixation forceps at a

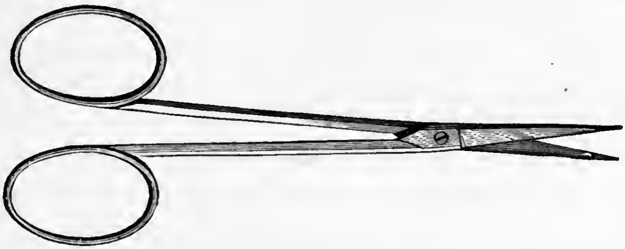


FIG. 104.

point close to the corneal margin and opposite the position of the intended incision. The forceps are held in the left hand while the operator takes the lance-shaped knife in the right hand. In making the incision the tough nature of the cornea must be remembered, and if the force applied to the knife is not proportioned to the resistance of the cornea, the knife may be suddenly pushed into the anterior chamber and the iris or

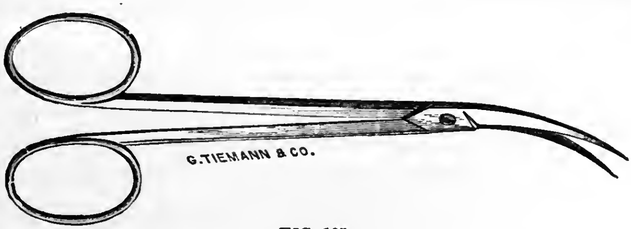


FIG. 105.

lens wounded. If the proper direction is not given to the knife, it may split the layers of the cornea and not enter the anterior chamber, an accident which may be disastrous. The point of the knife is now directed towards the centre of the eyeball at the location of the incision, and gently passed through the cornea, when its direction is changed by depressing the handle until the blade of the knife is parallel to the

surface of the iris, when the incision is completed by turning the blade first to one side and then another, until the inner line of the incision is of the same length as the outer. The knife is then gently withdrawn and the anterior chamber is emptied by the aqueous finding an exit through the wound,

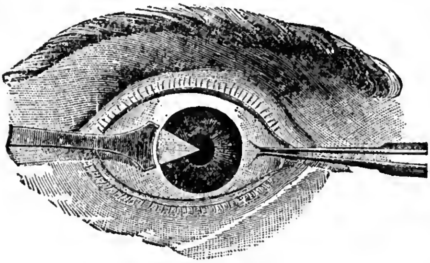


FIG. 106.

and the iris and lens move forward. The fixation forceps are now removed and the iris forceps are then taken in the left hand and the scissors in the right, the forceps are introduced closed into the wound and then allowed to open, and the iris, as it floats between the blades, is seized and withdrawn, put slightly on the stretch, and with one, two, or three cuts of the scissors, the portion desired is removed. Blood may be effused into the anterior chamber and may be removed by slight pressure upon the scleral edge of the wound with a spatula, and the application of a bit of soft linen to the wound, but no considerable effort or pressure should be used as the blood will be speedily absorbed; no portion of the iris or small clot must be left in the wound. A few drops of boracic acid solution may be dropped into the eye to wash out any blood or secretion of the conjunctiva. A compress bandage is then applied and the patient placed in bed. In all cases where there has been no increased tension, a drop of atropine solution is put in at the next dressing. Fig. 106 shows the position of the wound

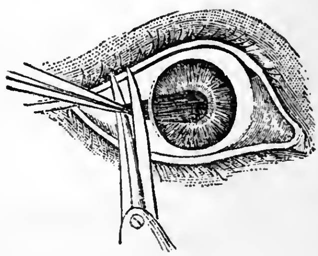


FIG. 107.

when the iridectomy is made outward; Fig. 107 the withdrawal of the iris by the forceps and the application of the scissors which are applied close to the sclera before the cutting. Fig. 108 shows the appearance of the coloboma, or fissure of the iris, after the operation, the dotted lines showing the loca-

tion of the wound when made within the sclera. When the anterior chamber is very shallow, as in glaucomatous conditions, the operative procedure is the same as before, except that a narrow cataract knife (Fig. 102) is used and the point of the knife introduced into the extreme limit of the anterior chamber,

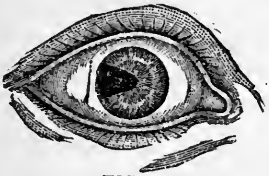


FIG. 108.

or about half a line, or 1 mm., or even more, behind the transparent edge of the cornea, and an incision made parallel to the surface of the iris; the iris is well drawn out and cut off close to its attachment with two or three strokes of the scissors. Fig. 109 shows the line of incision and the size of the coloboma when made in an upward direction. The eye is bandaged as before and the dressing changed once a day, but no atropine used.

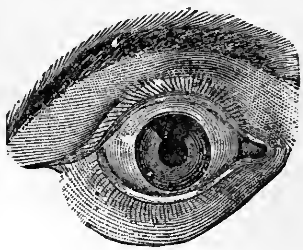


FIG. 109.

The reaction following these operations upon the iris is usually very slight if properly done, and no accidents have occurred. The internal administration of Aconite, Arnica or Calendula undoubtedly hastens the recovery and prevents possible inflammatory action.

Iridotomy, or Wecker's incision of the iris, is an operation which is sometimes required after the removal of the lens for cataract. The iris, from inflammation following extraction, becomes adherent to the lens capsule by the formation of a

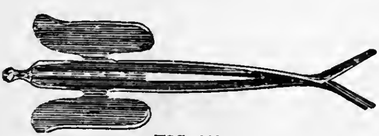


FIG. 110.

false membrane, or the pupil is occluded. The operation is performed as follows: An incision is made, usually at the upper part of the cornea, about one-fourth of an inch long by a keratome, the point being pushed obliquely downward through the pupil into the vitreous. Into the corneal wound, Wecker's scissors, or Liebold's (Fig. 110) are introduced closed. When the point reaches the opening in the pupil, the blades are allowed to

open, and one is passed behind and the other in front of the iris, which is divided by a single cut. The iris, which has been upon the stretch, immediately separates and a slit pupil results. In some cases two cuts may be required and a somewhat triangular-shaped pupil is made. Atropine is instilled, a bandage applied, and rest prescribed for three or four days.

Iridodesis, or Critchett's operation, consists in making an opening in the cornea anterior to the scleral junction, drawing out the iris with a hook and tying a fine silk thread around the withdrawn iris, and leaving the latter to slough off. The pupil by this means is dragged opposite a portion of clear cornea. The operation, however, is liable to lead to cyclitis or sympathetic ophthalmia, and has been superseded by the operation of iridectomy.

Corelysis is an operation devised for the separation of the adhesions of the iris to the lens capsule. A small incision is made in the cornea and a blunt hook or toothless iris forceps introduced and the adhesions separated by traction; the danger of rupture of the capsule and contusion of the iris is great, hence the operation is not commonly performed.

Iridodialysis.—In opacities of the cornea where only a narrow rim of transparent tissue remains, instead of making an iridectomy, which would leave a hazy scar at the margin where the incision is made, an opening is made through the opaque portion, a pair of fine forceps introduced and the iris gently torn from its attachment beneath the transparent portion of the cornea, and a portion of the iris drawn out through the wound and cut off close to the surface.

CHAPTER XIV.

DISEASES OF THE CILIARY BODY.

ANATOMY.

The ciliary body consists of a plaited zone containing the ciliary process and the ciliary muscle, lying between the iris and the ora serrata, and is a direct continuation of the choroid. It is made up of the ciliary processes, meridional folds of the choroid, some seventy to eighty in number, which rise gradually from the ora serrata and are continued forward to the iris. These processes have the same structure as the choroid, except its capillary layer, and are covered by the retinal pigment. In the depressions formed by the plaits, fit corresponding projections of the zonule of Zinn, a transparent membrane continuous with the envelope of the vitreous and which also forms the suspensory ligament of the lens.

The ciliary muscle occupies the anterior and more internal portion of the ciliary body between the ciliary process and the sclerotic, and consists of bundles of grayish, unstriped muscular fibres which take three different directions. The outer, near the sclerotic, which form the thickest part of the muscle, arise from a tendinous ring on the inner side of the canal of Schlemm, take a meridional direction and are lost in the choroid; the middle fibres diverge in an oblique direction and form a circular plexus, while the third layer occupies the anterior and most internal portion of the ciliary body and is made up of separate circular bundles which form the sphincter,

or ring muscle of Müller. The ciliary muscle is supplied by a filament from the third nerve, which has been stated to have a separate origin in the brain, and is probably the exclusive agent in the production of accommodation.

The ciliary body is firmly joined to the sclera at the sclero-corneal junction, more posteriorly it is loosely attached to the sclera by the supra-choroidea and is largely supplied with congeries of fine blood-vessels which also form two arterial circles, whose office is to afford nourishment for the crystalline lens and to secrete the aqueous humor. It is highly supplied with ciliary nerves derived from the long and short ciliary, which form a rich plexus with minute nerve ganglia in its tissue, while all the nerves which go to the iris pass through it.

DISEASES OF THE CILIARY BODY.

The ciliary body, from its situation between the iris and choroid, and its direct connection with them through similarity of structure, is liable to participate in inflammation of these structures. In inflammation of the iris the ciliary body is likely to be affected by the extension of the inflammation backward, while if the ciliary body becomes the seat of inflammation the iris is almost sure to become inflamed. Since the nourishment of the lens and the anterior portion of the vitreous is mainly derived from the ciliary body, any diseased condition of the latter interferes at once with their proper nutrition, and changes occur, which may result in opacities or in a cataractous condition of the lens, or a fluid condition of the vitreous. The abundant nerve supply of the ciliary body, which brings it into such intimate relation with all important parts of the eye, renders any inflammation of the part likely to lead to serious complications and hence is of the utmost importance and exceedingly dangerous. It is impossible, except in very rare cases, to separate inflammations of the ciliary body from those of the iris, as it is impossible to examine the condition with the ophthalmoscope and the inflam-

mation extends so rapidly to the iris that the diseased condition of the latter masks that of the former.

CYCLITIS.

Symptoms and Diagnosis.—Hyperæmia and inflammation of the ciliary body is characterized by injection of the vessels of the ciliary zone, congestion of the conjunctiva, intense photophobia and lessened vision, without marked change in the iris beyond the hyperæmic condition. There is exquisite tenderness over some portion, or the whole, of the ciliary region when pressed upon through the closed lid. There are also severe neuralgic pains which affect the whole eyeball and the side of the head, even extending down the neck. The anterior portion of the vitreous becomes clouded and examination with the ophthalmoscope is impossible. Tension may be doubtful, or, as the disease advances, becomes increased and atropine has but little effect upon the iris or upon the paroxysms of pain. A suppurative stage may even be entered upon without a purulent inflammation of the iris occurring, and pus may appear behind the lens or in the anterior chamber.

Causes.—Low conditions of the system, suppressed menstruation, and slight or ill-treated attacks of iritis, seem to excite it. It has been observed in children after typhoid or scarlet fever. It may also occur from syphilis, rheumatism and struma, and be consequent upon diseases of the cornea.

Treatment.—Hot applications, moist or dry, according to the comfort of the patient, should be used and absolute rest of the eye during the attack of the inflammation and for a long period after recovery has taken place prescribed. The general treatment of the acute affection will be similar to that of iritis and atropine or duboisia are to be used as in iritis. Much attention must be given to the general health, and the diet made nutritious and generous if the patient is ill-nourished or in a feeble condition. The chief reliance must be placed upon the use of internal remedies, the general indications for which will be found amongst those which have been already

given under iritis. Among those remedies, Bell., Bry., Gels., Hepar, Kali iod., Merc. cor., Merc. iod., Rhus or Silicia will be likely to be useful.

IRIDO CYCLITIS.

SYMPTOMS AND DIAGNOSIS.—Inflammations of the iris when extended to the ciliary body, exhibit either a serous, plastic, or purulent form; there is consequently exudation and swelling of the structures of both, with exudation into the posterior chamber and behind the lens. The vascularity and pain are greater than when the iris alone is affected, and there is sharp pain which causes the patient to suddenly shrink back when the ciliary region is touched through the closed lid by the finger. The vision becomes greatly impaired from the opacities in the vitreous and there is scarcely any dilation of the pupil when atropine is used. In the serous variety there is increased tension in the acute form, which in the chronic form is replaced by a soft condition of the eyeball which results in atrophy of the globe, or *Phthisis bulbi.* The iris becomes discolored, often grayish and atrophied.

In the plastic inflammation the iris becomes attached over the whole surface of the lens and dense whitish masses fill the posterior chamber, often extending up onto the posterior surface of the lens and into the vitreous. These masses of exudation in and upon the ciliary body contract, after a time, and draw the iris backward, deepening the anterior chamber, and bringing about changes in the ciliary body itself, the vitreous and also the lens. The suppurative condition rapidly involves the whole eye, producing *panophthalmitis* with complete destruction of the eye. The period of congestion may be short and the pus in the anterior chamber noticed among the early symptoms. The prognosis is more grave than when the iris alone is implicated, as the changes in the vitreous, lens or choroid, which result, destroy vision.

CAUSES.—The causes are the same as those already given under cyclitis.

TREATMENT.—This does not differ from that of the various forms of iritis which may involve the ciliary body.

TRAUMATIC CYCLITIS.

The most frequent form of inflammation of the ciliary body is that arising from injuries of this structure, as wounds, or lacerations of the eyeball in the ciliary region; wounds in this region being more dangerous than in any other part of the eye. The penetration of the ciliary body by small bodies of any description, or their lodgment in it, are very prone to excite a most destructive inflammation of the part and become a very common cause of sympathetic ophthalmia. The ciliary body, under these circumstances, becomes the seat of a plastic inflammation which rapidly disturbs the relation of the interior structures of the eye to each other. These masses of white exudation oftentimes extend out into the vitreous and onto the retina, becoming organized connective tissue, which, after a time, contracts and causes separation of the retina from the choroid, or even detachment of the ciliary body from the sclera.

SYMPTOMS.—The symptoms do not differ from those of cyclitis from other causes.

TREATMENT.—In the beginning cold applications should be made, as the attack may be aborted by their use. Where the disease has become established, it is to be treated as indicated for cyclitis. Later, it may become necessary to remove the eyeball. If there is a foreign body within the ciliary body, or within the eyeball, and cyclitis is imminent, enucleation should be practised at once.

FUNCTIONAL DISEASES OF THE CILIARY MUSCLE.

PARALYSIS OF THE ACCOMMODATION.—*Cycloplegia*, or paralysis of the ciliary muscle, which causes total loss of power of the accommodation, is usually associated with mydriasis from paralysis of the sphincter pupillæ, as both are supplied by

branches of the motor fibres of the ciliary ganglion. One eye alone is generally affected, though the paralysis may affect both.

SYMPTOMS.—The marked dilatation of the pupil, together with the loss of power of distinguishing near objects, indicates this condition. If vision is restored to its normal condition by a convex glass the diagnosis is then complete. Objects often appear smaller because they seem nearer than they really are. In myopes the disturbance may be very slight, but with hyperopes the distant vision may also be affected, so that vision is much lessened.

CAUSES.—The paralysis may arise from idiopathic, traumatic, syphilitic and rheumatic causes affecting the third nerve, or result from the use of mydriatic drugs. When idiopathic the condition may have been excited by prolonged use of the eyes for near and fine objects. More or less complete paralysis may occur after diphtheria and is then usually accompanied by some paralysis of the soft palate, and without affection of the mobility of the eye. Blows upon the eye sometimes cause it. Syphilis and rheumatism are the more frequent causes, and the lesion may exist in the brain or in the course of the branches of the third nerve, in the orbit, or in the ciliary ganglion. Mydriatics affect the accommodation as well as cause dilatation of the pupil. Atropine and homatropine are more commonly used for the purpose of paralyzing the accommodation than the other mydriatics, and the former much more frequently than the latter.

TREATMENT.—The treatment must be directed to the cause, and, as already stated, the paralysis is often symptomatic of some deep-seated and serious affection, hence will require such remedies as may be adapted to this condition, as it is frequently associated with paralysis of the other ocular muscles. The treatment is the same as that already discussed for paralysis of the muscles. When uncomplicated, the use of such remedies as Causticum, Arg. nit., Dubois., Physostig., Kali iod., Opium and Paris quad. may be beneficial. Faradization or galvanization is often of benefit in addition to the internal remedies. Eserine, or pilocarpine, locally is sometimes of benefit in stimulating the paralyzed muscle.

PARESIS OF THE ACCOMMODATION, or *Accommodative asthenopia*, is much more common than paralysis and is not accompanied by any change in the mobility of the eyes. It is frequently associated with a potential weakness of the extrinsic muscles of the eyeball.

SYMPTOMS.—The external appearance of the eye may give no indication of the weakness of the accommodation. The eye may appear clear, the action of the extrinsic muscles good, the pupil normal, the ophthalmoscopic appearances negative, and the visual power perfect, but the effort at reading or doing fine work cannot be continued except for a very short time. A feeling of fatigue and tension comes on so that the eyes must be closed and rested for a few moments until they regain their power. Objects may become indistinct, the letters in reading blur, the eyes feel hot or painful, and an aching arises in the brow and severe frontal or occipital headache follows and, perhaps, nausea and vomiting, if the effort is continued or the attempt to read is made by a dull or artificial light. When the condition has existed for a time, conjunctival or retinal hyperæmia may result.

CAUSES.—The common causes of loss of tone of the ciliary muscles are refractive errors; these may be very slight and will require careful investigation. The agency of hyperopia in causing accommodative asthenopia has already been considered. The weaker degrees of astigmatism are often the exciting causes. The paretic condition and the development of the asthenopic symptoms seem to depend greatly upon the degree of irritability of the nervous system of the individual. It is frequently the result of general weakness and follows acute diseases or occurs during the course of chronic constitutional diseases.

If is a frequent accompaniment of general neurasthenia, or the affection of the ciliary muscle may occur subsequent to the improvement of the general tone. It is often a sequela of typhoid, and acute exanthematous fevers, or is associated with diseases of the uterus and digestive tract.

TREATMENT.—Glasses which correct any refractive error

that may be discovered must be prescribed, and attention given to the improvement of the general tone of the system. A good and generous diet is oftentimes necessary in these cases, as well as moderate and daily exercise. The galvanic current, with one pole upon the closed eyelids and the other upon the nape of the neck, is often a valuable adjuvant in the treatment. The methodical exercise of the eyes in reading, as directed for muscular asthenopia, will also be useful. In addition to the indications for the remedies given under muscular asthenopia which is often associated with accommodative asthenopia, the following should be consulted.

REMEDIES.

Duboisia.—Paresis of the ciliary muscle. The accommodative effort can be sustained only momentarily and hyperæmia of the conjunctiva and lachrymation occur from attempted use of the eyes.

Conium.—The letters run together on reading and the effort brings on vertigo or headache. Burning pain, deep in the eye, may be complained of and the light is usually disagreeable or painful.

Physostigma.—While more valuable in spasmodic affections of the ciliary muscle, it is also curative in some cases of paresis of the accommodation following diphtheria.

Argentum nit. — Paresis following diphtheria, or in hyperopes, and weakness of the accommodation after herpes frontalis.

Lilium tig.—Weakness of the accommodation which has been preceded by an irritable condition of the ciliary muscle. There is usually photophobia, burning, smarting and heat of the eyes after use, and general relief of the eye symptoms from the open air.

Jaborandi. — Alternate contraction and relaxation of the ciliary muscle associated with uterine disturbance or with refractive errors. The effort to read or use the eyes for near work frequently causes nausea and even vertigo.

Spasm of the Accommodation.—Tonic spasm of the ciliary muscle is not uncommon in hypermetropes, astigmatics and myopes and also occurs in normal eyes. It frequently complicates muscular asthenopia. The contraction of the muscle relaxes the suspensory ligament, so that the lens is constantly in a state of increased convexity and the function of accommodation is interfered with and myopia simulated.

Symptoms and Diagnosis.—Distant objects are only seen indistinctly, while near objects are clear; the latter are held closer to the eye than they should be and fatigue, pain, or headache follows. If these patients are examined with glasses, the distant vision is improved or made perfect by the use of concave glasses, but it will be noticed that, while a weak concave glass, $\frac{1}{48}$ or $\frac{1}{36}$, makes the distant vision perfect, they can only read No. 1 at six or eight inches, when even a myope of much greater degree would read it at twelve inches. This should excite our suspicions and on an examination with the ophthalmoscope in the direct method, we shall find that the refraction is hyperopic, astigmatic, or even myopic; the pupil is often much contracted in these cases though not infrequently appearing perfectly normal.

The late Dr. Woodyatt called the attention of the profession, some years ago, to the fact that in the spastic contraction of the ciliary muscle, astigmatism became apparent and was undoubtedly due to an irregular action of certain sets of the meridional fibres which probably cause more or less tilting of the lens. I have repeatedly verified the statements then made by him in cases in my own practice, and have seen the same good results follow the administration of Lilium tig. and Physostigma in causing the disappearance of the apparent astigmatism.

Causes.—Spasm is of frequent occurrence in children who are hyperopic and results from the perpetual strain which is occasioned by such eyes. In older persons with hyperopic refraction, who are constantly using the eyes for near work or fine objects, the ciliary muscle gets into a state of tonic contraction which cannot be relaxed at the will of the patient.

An emmetrope may induce the same condition by prolonged use of the eyes for near work. In myopes it is produced by an irritable condition of the eye or from the use of glasses which are unnecessarily strong. It also arises in connection with some retinal affections or is the accompaniment of chorea.

TREATMENT.—Complete rest of the eyes must be enforced, and the most effective treatment consists in giving the ciliary muscles rest by the daily use of atropine solution until there is a complete relaxation of the spasm, when the true condition of the refraction should be determined and the necessary glasses worn constantly. In milder cases, rest of the eyes from near work and the use of such remedies as Physostigma, Jaborandi, Lilium tig., or Agaricus will relax the spasm to such a degree that the refractive anomaly can be determined and corrected.

Physostigma. — Particularly serviceable in relaxing the spasm occurring in myopic eyes; the book is brought closer to the eyes than formerly and use of the eyes soon becomes uncomfortable or impossible. Twitching of the eyeball is often present.

Jaborandi.—More useful in spasm of the accommodation occurring in hyperopic, myopic or astigmatic patients. The vision seems to disappear temporarily when an attempt is made to look at fine objects. Moving objects, as the people or teams in the street, occasion headache, vertigo or nausea.

Agaricus.—Useful in spasm of the ciliary muscle when accompanied by spasmodic conditions of the lids or ocular muscles.

Lilium tig.—Spasm of the accommodation in light degrees of myopic astigmatism, when cylindric glasses are indicated and yet are not worn with comfort. It has a marked effect in relieving the asthenopic symptoms which accompany these cases of spasmodic action of the ciliary muscle.

CHAPTER XV.

SYMPATHETIC OPHTHALMIA.

Under the general term *sympathetic ophthalmia* are included a large number of ocular lesions which arise in one eye from disease or injury of the other.

That there is a sympathy existing between the two eyes has long been recognized. It may be observed even in very slight external affections, as when the presence of a foreign body upon the cornea or beneath the lid, or a slight attack of conjunctivitis in one eye, excites more or less "fellow suffering" in the other.

This, however, does not result in any severe diseased condition of the sympathizing eye. When the injury is more severe or affects certain regions of the eye, or the inflammation is more deep-seated, the other eye may take on a very severe inflammatory condition.

The importance of sympathetic diseases, both with reference to their easy recognition and proper treatment, can hardly be over-estimated since they may lead to an impairment of the functions of the eye or destruction of its delicate tissues and loss of sight.

Sympathetic ophthalmia is commonly divided into a stage of *sympathetic irritation*, when there is only functional disturbance, and one of *sympathetic inflammation*, when a destructive inflammatory process follows.

SYMPATHETIC IRRITATION is practically the prodromal stage of sympathetic inflammation, but it may also appear and not

lead to that dangerous condition of which it is commonly the forerunner. It is marked by a paresis of the accommodation which causes difficulty or impossibility of accommodation. Any attempt to use the eyes for near work is followed by lachrymation and congestion of the eyeball and general irritable appearance. There is commonly more or less photophobia and perhaps some contraction of the visual field, flashes of light or other phosphenes, and frequent and temporary failure of the vision. These symptoms disappear quickly on the removal of the exciting eye.

SYMPATHETIC INFLAMMATION.—The most frequent form of the lesions of the eye which are included under the general name of *sympathetic ophthalmia* is that of sympathetic iritis, or irido-cyclitis, yet among the many other ocular affections which are superinduced in the second eye after disease or injury of the first, are ciliary neuralgias, irritation and inflammation of the optic nerve and retina, inflammation of the conjunctiva, cornea, and choroid. Glaucoma and diseases of the vitreous and the lens have also been reported as arising from the transmitted disease tendency of the injured eye.

The ciliary nerves, which are believed to be the important agents in the transmission of this sympathetic disturbance from one eye to the other, are derived from the ciliary ganglion, a minute, flattened body about the size of a pin-head, situated in the posterior portion of the orbit between the optic nerve and the external rectus muscle, and which serves as a centre for the supply of nerves, motor, sensory, and sympathetic, to the eyeball. Its roots are derived from the fifth, the third, and the sympathetic nerves; while from its fore part proceed the ciliary nerves, some fifteen or twenty in number, which pierce the sclera anterior to the optic nerve entrance, and run forward between the sclera and choroid, after further subdivision, to the ciliary muscle in which they form a fine net-work from which the cornea, iris and ciliary body receive their nerve supply. The naso-ciliaris nerve which gives off the sensitive branch of the fifth to the ganglion also sends two or three small branches, the long ciliary nerves, direct to the sclera,

which pierce it near the entrance of the short ciliary nerves and pass forward to the ciliary region in the same manner as the others. This bountiful nerve supply of the ciliary region, which is also thus brought in close connection with all other parts of the eye, renders any injury or disease of this region of the utmost importance to the practitioner from the fact of the danger of most serious complications which are always imminent.

The channel of transmission of the inflammation from one eye to the other can not be said to be invariably the same. Recent researches seem to have settled the point that while the sympathetic invasion is in many cases justly attributed to the agency of the sensitive or sympathetic fibres of the ciliary nerves, yet other cases arise by way of the optic nerves, the blood-vessels or their nerves, and the lymph tracts.

CAUSES.—The most frequent causes of sympathetic inflammation are injuries, especially in the region of the ciliary body; irido-cyclitis; foreign bodies in the eye; and surgical operations involving the iris or ciliary body. Displacements of foreign bodies which have been encysted, contraction of cicatrized tissue, bony deposits in the choroid, or the wearing of an artificial eye upon a shrunken stump may also awaken the dormant tendency to sympathetic inflammation. Wounds likely to contract during the process of healing, and irritating foreign bodies are much less dangerous when they occupy positions beyond the ciliary region. The danger of transmission of the inflammation after the injury is generally greatest during the five or six weeks following the accident. Yet in one case I have seen the other eye affected on the twelfth day after injury. On the other hand years may elapse before any trouble is noticed. In one case I have noted, thirty years had elapsed. There exists, then, no period when danger can be said to have disappeared, as after twenty-five or thirty years an eye has become destructive of its fellow.

As a rule all eyes which have undergone a suppurative inflammation, as in panophthalmitis, are not likely to cause sympathetic trouble, owing to the destruction of the nerves which results from the suppurative process.

SYMPTOMS.—Sympathetic inflammation may commence insidiously, or burst out suddenly without the slightest hint or warning having been conveyed either by fatigue or impairment of the accommodation or other symptoms as photophobia and ciliary injection.

On the other hand we may have the symptoms of weakened accommodation, frequent and transitory failure of vision, photophobia and lachrymation, and general complaint of fatigue of the eyes with inability to use them; these symptoms have already been spoken of as those of *sympathetic irritation*, which may exist for some time before the nerve destructive process follows, or they may be the immediate forerunners of the most dangerous form of sympathetic inflammation.

Sympathetic ophthalmia usually assumes the form of a plastic inflammation of the iris and ciliary body, or iris and choroid. There is in this inflammation a remarkable tendency of the iris through this plastic effusion to become adherent over the whole extent of the lens, causing complete posterior synechia, the iris becoming thus perfectly immobile, and the pupil frequently filled with the plastic exudation. The tension of the eyeball, which early in the attack was increased by choking up of the channels of exit at the corneal junction, now becomes lessened from the pressure of the exudation upon the blood-vessels causing their obliteration. The nutrition of the vitreous and lens are thus interfered with and partial or complete atrophy of the eyeball results.

In some cases the sympathetic inflammation assumes the form of a serous irido-choroiditis, which is less dangerous than that already alluded to, but unfortunately it usually passes over into the more dangerous type of adhesive inflammation. The tension of the eyeball, which early in the disease may have been increased by pressure of the mass of exudation upon the canals of exit at the margin of the cornea, now becomes reduced owing to the obliteration of a considerable number of vessels in the most vascular region of the choroid from the choking process resulting from the interpo-

sition of the exudation upon and around the vessels. The nutrition of the vitreous humor is disturbed and its transparency lost, while the crystalline lens becomes opaque, and partial or complete atrophy of the eyeball results.

Diagnosis.—The early sympathetic phenonema in the more common form of inflammation, that of irido-cyclitis plastica are, intolerance of light, ciliary injection, and discoloration of the iris. The iris exhibits a marked tendency to become adherent to the greater part or whole extent of the lens, speedily bringing about complete posterior synechia. For a short time the pupil appears depressed, but soon from similar adhesions between the ciliary body and the sclerotic and a movement of contraction in the adherent portions, which depresses the edge of the lens, the anterior chamber becomes wider toward the periphery, while the pupil advances considerably nearer to the posterior surface of the cornea. If to this characteristic appearance be added an immovable and vascular iris, which, owing to the closure of the pupil by the plastic exudation forms an extended plane, the appearance will be so remarkable that, without any history of the case a diagnosis may at once be made.

A further examination will doubtless disclose the exciting cause as existing in the other eye.

Prognosis.—In young persons the atrophy of the eyeball, resulting from obliteration of vessels in the choroid, may be only transitory and we may find that the cornea again attains its normal curvature. The neoplastic masses undergo such a degree of atrophy and the tissue of the iris becomes so thinned that we may have a fair pupil resulting, and the vitreous may clear up so that we are enabled to examine the fundus and find that the inflammatory process has extended to the choroid, retina, or even the optic nerve. This affords sufficient explanation of the reason why loss of vision persists in spite of the general improvement. A phthisical condition of the bulb or atrophy may result from the disturbance of its nutrition.

Treatment.—The principal object of all treatment should be to remove as speedily as possible the sympathetic irritation

by enucleating the injured eye, as nothing is gained by its removal after the disease has become one of sympathetic inflammation.

An eye which contains a foreign body or has received a serious wound of the ciliary region should be removed early, unless the patient is constantly under surveillance so that we may be able to remove the eye at the moment when symptoms of irritation of the other eye appear.

When the sympathetic inflammation has involved an eye, no operative interference is of any value beyond that which may be necessary to relieve the pain, and the diseased condition is to be treated as already described for irido-cyclitis. When it takes other forms, as that of iritis-serosa, keratitis, conjunctivitis, retinitis or neuritis, the destruction of the eye is not so rapid and the removal of the eye even when the disease has become well marked may check it and the eye be not seriously injured.

While it seems a serious matter to deprive a person of an eye, which may be neither sightless nor painful, yet the knowledge that it is a menace to its fellow and may sooner or later result in utter loss of vision of the other, should cause us to instruct our patient of the extreme danger and advise its removal.

The danger then to be found in all cases of severe injury to the eyeball, is the possibility of loss of the remaining eye through the transmission of sympathetic ophthalmia. When this inflammation is once established no benefit is derived from the removal of the injured eye, hence it should be avoided by the immediate enucleation when symptoms of sympathetic irritation appear. If the injured eye has already lost all vision other than mere perception of light, and contains a foreign body, or is sensitive, and there is a probability of chalky deposits in the lens, or deposits of bony tissue in the choroid, or if the atrophied ball is sensitive or has attacks of inflammation or pain, enucleation is imperative at once unless the patient is constantly under supervision so that it may be removed immediately upon the appearance of any symptoms of sympathetic trouble.

The operation of enucleation is accomplished by dividing the conjunctiva close to the cornea by curved scissors, after the patient has been etherized, and the speculum introduced. The muscles are then raised upon the strabismus hook, divided close to the sclera, and then the scissors introduced following the convexity of the eyeball until the optic nerve is reached and divided; the ball is then held by the fingers or forceps, and the tissue carefully dissected until it is entirely free from the socket; the orbit is then sponged with cold water until the hemorrhage has ceased, a wad of absorbent cotton placed upon a bit of soft muslin over the closed lids, and a compress bandage applied for twelve hours, when it is removed and the orbit and lids kept wet by a decoction of calendula flowers. No pain or reaction follows in cases where the operation is carefully performed, and the orbit is usually in condition to wear an artificial eye in from two to three weeks.

To avoid the necessity of removal of the eye and the consequent use of an artificial one, the *operations of optico-ciliary neurotomy* and *neurectomy* have been devised; the results, however, have not so far been sufficiently conclusive for us to advise it as promising the advantages claimed for it. In the three cases in which I have made this operation, the results have not been satisfactory. It is only applicable to those cases in which there is no foreign body, deposit of bone, or growth in the eye, and when the eye itself presents no marked deformity. The dangers are from hemorrhage, or orbital cellulitis as a result of the operation, or the reunion of some of the nerves afterwards, and a recurrence of the symptoms of sympathetic irritation.

The operation of neurotomy is performed by making a horizontal incision in the conjunctiva extending from the cornea to the outer canthus and the external rectus muscle divided at the insertion of its tendon after having secured the muscle by a thread; the eyeball is then forcibly rotated towards the inner canthus, and on the introduction of scissors the optic nerve is divided and the eyeball further rotated inward until the ciliary nerves are brought into view and carefully severed at their

entrance into the sclera; having thus carefully divided all of them, the eyeball is rotated outward into position, the tendon of the external rectus muscle is united by a stitch, and the conjunctiva brought together by another suture, and the pressure bandage applied.

The operation of neurectomy may be made at the inner canthus without division of the muscle, by making an incision of the conjunctiva, between the internal and superior recti muscles with the blunt strabismus scissors, and separating the tissue until the optic nerve is reached when a strabismus hook is introduced and the optic nerve brought into view in the incision and divided as far back as possible; the portion adherent to the sclera is then seized by the fixation forceps, and the ciliary nerves carefully divided and then the optic nerve is severed close to the sclera, the eyeball rotated into position, the wound in the conjunctiva closed with a suture and the bandage applied as in the former operation. The hemorrhage and prominence of the eyeball is less with this method of operation than the former and gives, I believe, the best results.

The operation for enucleation is more easily performed and much safer in lessening the future dangers of any sympathetic trouble.

USE OF ARTIFICIAL EYES.

An artificial eye (Fig. 111) is a hollow hemispherical shell of enamel which is so colored as to correspond with the iris and sclera of the other eye. They are made of various sizes and shapes and may need to have the edges notched to fit irregularities in special cases.

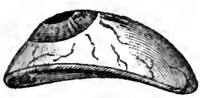


FIG. 111.

After enucleation, the capsule of Tenon with the muscles attached is left to form a cushion upon which the artificial eye rests and thus partakes somewhat of the movements of the sound eye. When the contents of the globe are evacuated and the sclera left the motion of the artificial eye is better. If much of the contents of the orbit has been removed, they are of little use. An artificial eye may also be worn in some

cases where the eye has been lost from disease or injury, provided that the cornea has been destroyed and that no foreign body is retained in the atrophied ball which should be neither sensitive nor painful. In children it is advisable to insert an artificial eye which is to be worn a few hours each day, in all cases where an eye has been removed or is much atrophied, as the arrest of development of the orbit and corresponding side of the face is materially lessened.

When the conjunctiva has been extensively removed or destroyed, or the membrane atrophied from disease or presents cicatricial bands, the conjunctival sac becomes too small to retain an artificial eye. Occasionally the transplantation of portions of the conjunctiva of the rabbit, and the excision of the tendinous bands may enable us to insert an eye with good cosmetic effect.

Care must be exercised in adapting the artificial eye to the requirements of individual cases, and the eye should never be so large as to prevent the closure of the eyelids over it. They should not be so large as to press upon the walls of the orbit, and should have a notch upon the upper and inner edge corresponding to the supra-orbital nerve so as not to cause any irritation of that nerve from pressure. Under all circumstances the artificial eye should be worn with perfect comfort, and should not be inserted for three or four weeks after removal of the eye, or until all inflammation and irritation have disappeared.

When irritation or inflammation arise from their use, or the conjunctiva becomes granular, they must be laid aside and the condition relieved by treatment when they may be again worn. If there is much conjunctival discharge, the eye should be examined for any roughness or loss of smoothness on its surface or edges. An astringent collyrium should be applied to the conjunctival sac until the irritation is removed, and if the eye is found defective it should be replaced by a new one.

To insert an artificial eye (*prothesis oculi*) the upper lid is raised by the fingers of one hand, and the upper edge of the eye which has been previously moistened is introduced beneath

it and the lid allowed to fall. The lower lid is now depressed until the lower edge of the shell is pushed into the lower palpebral cul-de-sac, when the eye finds its proper position. To remove it, the lower lid is everted and the thumb-nail or the head of a hair-pin is introduced under the lower edge of the shell which is slightly pulled forward when it at once falls into the hand held to receive it. Should it fall upon a hard surface it will probably be broken. Those who wear artificial eyes soon acquire the knack of safe and easy removal.

The eye should always be removed at night, washed gently in water and carefully dried, when it should be placed in a small box containing a layer of cotton until the following morning demands its use.

After a longer or shorter time, a few months or a year or two, depending upon the condition of the conjunctiva, the enamel becomes worn and rough and excites a conjunctival irritation and the eye must be replaced by a new one.

CHAPTER XVI.

DISEASES OF THE LENS.

ANATOMY.

The crystalline lens is a transparent, solid body, of a double convex shape and rounded circumference. Its antero-posterior axis measures 5 mm., and its diameter from 8 to 9 mm. It is enclosed in a transparent elastic membrane, the lens capsule. The anterior surface of the lens is in contact with the iris, which rests slightly upon it towards the circumference. The posterior surface is more convex than the anterior and rests in the hollow formed for it in the vitreous. It is composed of flat, hexagonal, ribbon-like plates with serrated edges, which are held together by cement substance. These fibres are S-shaped and so arranged that the two ends are brought more or less close together, while the body of the fibre is directed towards the circumference of the lens.

The fibres are arranged in lamellæ, which overlap each other and form three triangular-shaped sectors with bases towards the circumference and the points meeting at the center of the lens. During infant life the lens is more globular in shape, while in adult life the convexity is lessened, until in old age there is considerable flattening of the curvatures.

The lens does not present the same density throughout, the central portion, or nucleus, being more dense than the outer or cortical portions, which are soft and easily detached from the nucleus. In the adult lens, faint white lines or sutures are seen directed from the poles to the circumference; these are usually three in number, but may be more, and diverge from each other like rays, those of the two surfaces alternating. These lines become apparent during life in some cases of cataract, and mark the place of intersection of the fibres in the lamellar segments.

The lens capsule is a perfectly transparent, homogeneous and very elastic membrane, permeable to fluids, and is the medium through which the nutrition of the lens is carried on. Its anterior portion is about twice as thick as the posterior, the latter being very thin at the posterior pole. The circumference is strengthened by the added fibres of the suspensory ligament of the zonule of Zinn. Upon the inner surface of the anterior portion of the capsule is a layer of columnar endothelial cells which are the matrix cells from which the lens fibres are developed, and in adult life only one layer of cells exists; this undoubtedly bears a close relation to the nutrition of the lens fibres, which is probably carried on more actively from the aqueous chamber than the vitreous. The capsule is very elastic, and rapidly contracts and puckers up when torn.

The zonule of Zinn, after it leaves the ciliary processes, splits up into fibres to be inserted into the anterior, and partly into the posterior surface of the capsule close to its periphery, in a peculiar zigzag manner. It forms with the hyaloid the so-called canal of Petit.

The hardening process, which the lens undergoes with the advancement of age, begins in the nucleus and advances towards the cortical substance, and this density when obliquely illuminated, gives an amber, or gray, hue to this portion of the lens. The function of the lens is to bring the rays, with the assistance of the other refracting media, to a focus upon the macula lutea of the retina, and hence any disturbance of its transparency affects the vision.

DISEASES OF THE LENS

CATARACT.

Cataract is the term applied to any opacity of the crystalline lens or its capsule, and is due to changes in the structure and composition of the lens fibres, or of the membrane inclosing the lens from proliferation of its endothelium or exudative deposits derived from neighboring tissues. The pathology of cataract varies with the causes which produce it, and consists of fatty degeneration or sclerosis of the lens fibres, or swelling of the lens fibres from the inhibition of fluid.

VARIETIES.—Cataracts may be divided into those where the opacity is situated in the lens, *lenticular cataracts*, or in the capsule, *capsular cataracts*. Lenticular cataracts are again classified according to the consistency of the lens into *hard*, *soft*, or *mixed;* according to condition into *simple*, *complicated*, *stationary* and *progressive;* according to the stage of the cataract into *incipient*, *immature*, *ripe*, *hypermature* and *degenerated*.

CAUSES.—The causes of cataract, excluding traumatic and capsular cataract, are still obscure and a matter of doubt and speculation. It appears most probable, as the lens depends for its nutrition upon the vitreous and aqueous humor, that any alteration or interference with its nutrition tends to render it opaque, and these morbid alterations in the condition of the vitreous or aqueous may depend upon local or constitutional causes. Among the local causes may be cited injuries to the eyeball, lens or its capsule, and inflammatory diseases of the interior portions of the eye. Of the more remote causes, rheumatic affections, syphilis, struma and sclerosis of the arterial coats. The changes in the lens may be induced by senile changes, alterations in the blood, or may arise from defective innervation.

The causes, however, vary with the individual, and there is no single cause which will comprehend all cases of cataract. Dr. Burnett, of London, has called our attention to the effect of the excessive use of sugar, salt and calcareous waters as

productive of cataract, and to this I would add the saturation of the blood with stimulants and narcotics as undoubtedly interfering with the proper nutrition of the lens.

SYMPTOMS.—There is usually slowly developed dimness of sight, distant objects lose their clearness, and near objects must be held closer to the eye. The vision is improved by turning the back to the light, or shading the eyes with the hand. The patient thinks that a change of glasses is necessary but finds nothing that will improve the vision, or the vision may be temporarily improved by concave glasses owing to the swelling of the lens. He may also find the vision improved by tinted glasses which will dilate the pupil by lessening the amount of light admitted to the eye. The vision is usually better in a dim light, or in the evening, rather than during the day. Again, the gas jet or lamp flame may have a peculiar irradiation. This is not to be confounded with the rainbow colors seen in cases of glaucoma. There is rarely any pain, but specks before the eyes and phosphenes are not infrequently complained of.

The objective symptoms consist in a grayish or whitish appearance of the pupil, which is usually contracted. The behavior of the pupil is of importance; if it is contracted and does not dilate rapidly under atropine it indicates an unfavorable prognosis for extraction of the lens. The field of vision in simple cataract is good and the patient quickly notices any variation in the light.

DIAGNOSIS.—While the diagnosis of cataract is not attended with much difficulty, we must at the time of the examination consider the location, extent and character of the opacity and also whether it is simple or complicated.

If the opacity is dense, it is readily recognized from the whitish or gray appearance of the pupil.

Opacities of the cornea must not be confounded with cataract, and when oblique illumination is used, the lenticular opacity will be seen behind the pupil. If the pupil is contracted, or if the opacity lies more towards the periphery of the lens, it will be necessary to dilate the iris with atropine to

fully define its character and extent. The smoky hue of the lens which comes from age and which is often associated with glaucoma, is not to be mistaken for true cataract; here the use of the ophthalmoscope, with a feeble illumination, will, when it is held ten or twelve inches from the eye, and the reflected light thrown somewhat obliquely from various points across the pupil, enable us to obtain a red reflex, and, at the same time, discover any real opacities which may be present, and which will appear black instead of gray when examined in this manner.

LENTICULAR CATARACT.

Cataracts affecting the lens fibres may be considered under four heads: the *soft*, *zonular*, *cortical* or *mixed*, and *senile* or *hard*.

SOFT CATARACT.

Soft cataract occurs under thirty years of age and is termed soft, because the nucleus up to that age has not acquired sufficient hardness to necessitate its consideration in the selection of an operation for the removal of cataract.

CAUSES.—It may be congenital, but more commonly results from injury to the eyeball, as punctured wounds of the lens or rupture of its capsule from blows, and sudden compression of the globe. It also arises as the result of certain inflammatory diseases of the choroid or retina which involve the vitreous and thus impair the nutrition of the lens.

DIAGNOSIS.—It is hardly possible to mistake this form of cararact, as the pupil presents a bluish white or pearly appearance, and when the iris has been dilated with atropine the whole lens appears like a little sac filled with a milky substance, as in Fig. 112; now and then more opaque or chalky looking spots, or the sparkle of cholesterine crystals may be seen in it, as in Fig. 113. With the focal illumination or with the ophthalmoscope the opacity is seen to involve the whole lens.

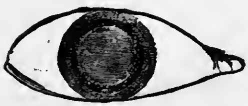


FIG. 112.

FIG. 113.

In some cases of traumatic cataract, masses of the lens substance may be found extending into the anterior chamber as a gelatinous mass, or the whole lens may be swollen and pressing forward upon the iris.

Prognosis.—Congenital cataracts give good results as far as surgical procedure is concerned, but as they are often the result of arrest of development, the gain of sight is uncertain, because of the imperfect development of other portions of the eye. It sometimes happens that the disintegrated lens substance is gradually absorbed and the shrunk and wrinkled opaque capsule, containing perhaps some chalky deposits, appears as an opaque membrane situated in the pupil slightly behind the iris, constituting in this case a capsular cataract.

The prognosis of the traumatic variety will depend upon the extent and nature of the injury, and the presence or absence of a foreign body in the lens or eyeball. When the cataract is complicated by other diseases of the eye the prospect of vision depends upon the nature of the complication, which also increases the surgical dangers.

Treatment.—The treatment of these cases is purely surgical, and two operations, those of discission and extraction, through an incision in the cornea, are used. In all cases of cataract occurring under thirty years of age the whole lens substance may be made to become absorbed by an operation which punctures the capsule and breaks up the lens fibres. In congenital cataract the operation should be made as soon after birth as possible, as the best results as to vision are obtained when the operation has not been delayed beyond a few months after the birth of the child.

Operation of Discission.—The operation for solution or absorption of the cataract (Fig. 114) is performed in the following manner. The pain from the operation is not sufficient to necessitate the use of an anæsthetic, except in young children. The pupil must be fully dilated with atropine and the patient placed in a recumbent position on an operating chair, or suitable sofa, before a good light. The eyelids are then separated by a speculum and a needle with a stop shoulder

is introduced a line in front of the sclerotic margin of the cornea, on its inner side, passed over the edge of the dilated pupil until the point rests upon the lens; a second needle is then introduced at the opposite point of the cornea until it also rests upon the centre of the anterior surface of the lens;

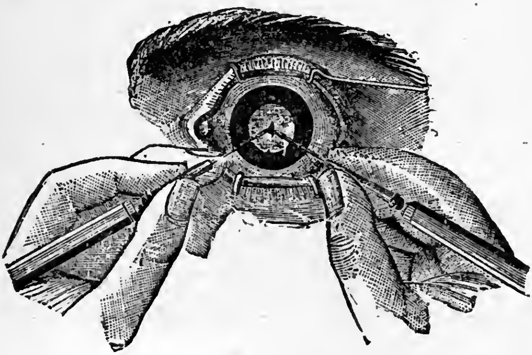


FIG. 114.

the capsule of the lens is then carefully torn through and the needles by a gentle drilling motion made to slightly enter the cortical lens substance. No pressure is to be made upon the lens, as it may be depressed into the vitreous, or injury to the ciliary body result from the tension of the zonule. The needles are now simultaneously withdrawn. The aqueous finds its way into the lens, which swells up and undergoes absorption. This process requires several weeks and the operation will probably have to be repeated at intervals of six or eight weeks until the whole lens is absorbed.

The after treatment, if no complications occur, is very simple. The eye is bandaged, atropine instilled sufficiently often to keep the pupil fully dilated, and the patient kept quiet for a few days until all irritation resulting from the operation has disappeared. The pupil should be kept well dilated during the periods intervening between the succeeding operations, and the eyes protected from strong light.

The dangers of the operation are, first, the swollen lens may cause an increased tension which may be rapidly destructive of vision. This arises from the too extensive rupture of the lens capsule, or from the effort to accomplish too much at the first operation, and probably from other causes which are not within the knowledge or control of the surgeon. If such a

complication should occur, an iridectomy must be made without delay, and the operation of linear extraction should be completed. Secondly, the swollen lens, or portions of it which have escaped into the anterior chamber, may press upon the iris and set up iritis, or if the ciliary body has been interfered with by pressure upon the lens during the operation, an iridocyclitis may arise. In such a case, the softened lens must be removed at once by linear extraction. Care must be taken not to rupture the posterior capsule with the needles, or the vitreous will mix with the lens substance and prevent its absorption.

The danger of the operation is least in young children and when the whole lens substance is softened down. It is greatly increased if the margin of the lens is transparent.

Operation for Linear Extraction.—(Fig. 115). This

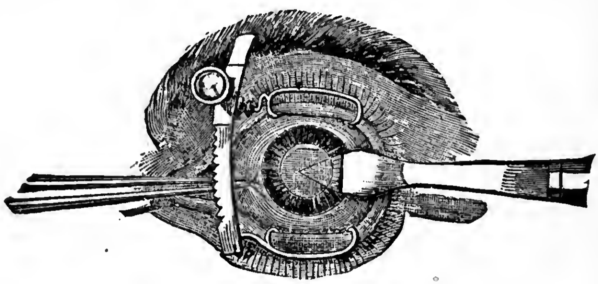


FIG. 115.

procedure is performed as follows: A needle operation, as just described, is usually performed first and may precede the extraction several days. If the lens is fluid this may be dispensed with. The preparation of the patient is the same as that for discission. An incision is made with a broad needle, or a keratome, about a line from the sclerotic margin of the cornea, and two and a half or three lines in breadth. A cystotome is then introduced into the anterior chamber, and the capsule ruptured in a line parallel to the incision in the cornea. Slight pressure upon the lower edge of the cornea with a curette may now be sufficient to cause the lens matter to flow out, or a narrow curette or spatula is introduced into

the wound (Fig. 116) and the lens substance allowed to flow out beside it.

The after treatment consists of rest in bed, a bandage and the instillation of atropine, together with the controlling of any reaction which may arise, by Aconite, Arnica, or Calendula, and cold applications.

THE OPERATION OF REMOVAL BY SUCTION is applicable only when the lens matter is in a fluid state and may be employed after the needle operation has rendered the lens very soft. The procedure is the same as for linear extraction, except that

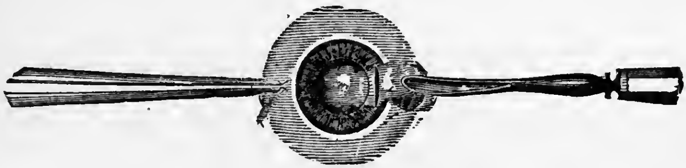


FIG. 116.

after the capsule has been ruptured, the point of a suction instrument is introduced into the lens and the pulpy or fluid matter is drawn into the tube of the instrument, until the pupil is clear. Care must be exercised to prevent a portion of the iris from being drawn into the instrument.

The advantages of these two methods over the simple needle operation is that time is saved, and the result of the operation, if successful, is at once more apparent and brilliant. While the needle operation is much slower in its results, the operation often requiring several repetitions, yet it is much the safer proceeding.

After either of these operations, a portion of the opaque capsule may remain; this must be treated at a later period by another needle operation as will be described under the operations for capsular secondary cataract.

ZONULAR CATARACT.

Zonular cataract is a variety of cataract in which a layer or zone of the cortical substance (Fig. 117) surrounding the nucleus is opaque while the remaining portions are perfectly transparent. At times, several of these layers are affected and the nucleus also.

FIG. 117.

CAUSES.—It is generally congenital, but may be formed during the first few months of life, and may depend upon hereditary syphilis or infantile convulsions.

SYMPTOMS.—During the early period of the child's life, opacities of the lens may be overlooked, as defective vision may not be apparent until the child is about two years of age, when he begins to use the eyes for near objects. He may even then, owing to the natural largeness of the pupil, see tolerably well; later, however, if the opacity encroaches upon the pupil the impaired vision is complained of. In many cases the vision is very defective and is frequently associated with, and may be the cause of, nystagmus.

DIAGNOSIS. — The opacity appears as a whitish-gray film, more commonly in the posterior cortical layers, and hence some distance behind the pupil. When the pupil is dilated with atropine and the lens examined by focal illumination (Fig. 118), the opacity will be found to encircle the nucleus, or the latter is itself opaque and whitish and with bundles of opaque lens fibres extending out from it into the clear remaining tissue. With the ophthalmoscope (Fig. 119) these opacities appear as dark rings or spots upon the red back-ground of the fundus.

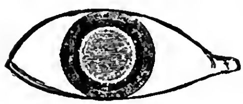


FIG. 118.

FIG. 119.

PROGNOSIS. — With very few exceptions these opacities remain stationary, the lenticular opacity is well defined, small, and the circumference of the lens clear. If, however, in addition to the central or peripheral opacity there are also small dots or streaks in the cortical substance, the cataract is apt to become progressive.

TREATMENT.—If the vision is fair, or when the opacity is not central, patients occasionally derive considerable improvement from the use of atropine, which keeps the pupils dilated and the vision is made temporarily better while its action is kept up. If the periphery is clear, a small iridectomy may be made at the inner and lower portion of the iris with very satisfactory results. If the opacity is central and dense, or is

progressive, the lens may be extracted, or removed by the more tedious process of discission.

CORTICAL OR MIXED CATARACT.

Cortical or mixed cataract is characterized by the appearance of opaque bundles of fibres, or striæ, in the cortex (Fig. 120), which commence at the circumference of the lens and converge toward the centre. The striæ may appear in the anterior, but more often in the posterior layers of the lens. These striæ in young people are white, pearly, and broad, and progress rapidly.


FIG. 120.

The term is also applied to that class of cases where the nucleus has become hard, as after forty years of age, when the cortical substance becomes opaque and the nucleus is involved later.

CAUSES.—When occurring under thirty-five or forty years of age, injuries of the eye and diseases of the interior structures by interfering with the nutrition of the lens are the exciting causes. When appearing later it is due to malnutrition or senile changes.

SYMPTOMS AND DIAGNOSIS.—The vision is lessened according to the amount and density of the opacity. The striæ are fully seen when the pupil is dilated, and when the cataract has fully formed. The degenerated cortical substance extends up to the capsule, and the iris, when not dilated, is observed lying immediately upon the opaque lens. When examined by the ophthalmoscope the striæ appear as dark lines as in Fig. 121, and when focal illumination is employed the streaks present a lightish appearance as in Fig. 122.


FIG. 121.

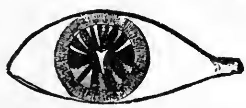


FIG. 122.

TREATMENT.—When the cataract is in an incipient stage, and when arising from constitutional enfeeblement, or diseased conditions of the interior tissues of the eye, the progress may be stayed by the use of such remedies as improve the general

condition of the blood and arrest the other local changes in the eye. When fully formed, and operative measures are desirable, the methods to be adopted for the removal of the cataract will depend upon the age of the patient; if under thirty, the operation for soft cataract will be indicated; if over this age, or after forty, the nucleus has become so hardened that the operation to be described for senile cataract will be necessary.

HARD OR SENILE CATARACT.

This is the most frequent and important variety of cataract. It is called hard, because it occurs late in life when the nucleus has become dense and hard, and the loss of transparency is frequently situated in this portion of the lens (Fig. 123); it is called senile, from the fact that it is usually associated with other changes in the tissues which result from advanced age.


FIG. 123.

CAUSES.—As persons advance in life senile changes take place in the lens by which its nucleus is rendered amber-colored, or smoky, and yet good sight is retained; this is not considered cataract, but these degenerative changes may advance still further and the process of osmosis becomes more difficult and the lens tissue opaque. The nutrition of the lens not being directly derived from blood-vessels, the condition of the lens from hardening of its texture is such that the circulation of the lymph through it is not sufficiently rapid to maintain the proper nourishment of the lens fibres, and the nucleus which is still further removed from the sources of supply, suffers and the immediate effect is loss of transparency, while later, there is a degeneration and a retrograde metamorphosis. Again, these changes may result from an interference with the circulation of the lymph currents in the vitreous, from local changes in the nutrient membranes of the eye, the choroid, or from an impoverished condition of the blood itself. We have in short, then, primarily, the lessened power of the lens to carry on its own nutritive processes, and secondly, an interference with its nutrition by causes not resident in the lens itself,

and particularly the want of proper nutrient elements in the blood supply of the eyeball. Undoubtedly the saturation of the blood with certain matters, as urea, sugar, salt, calcareous matters, or the retention of waste material in it in patients who use alcohol, tea, or coffee to excess, is sufficient to account for the loss of transparency.

Symptoms.—In senile cataract, the subjective symptom is commonly progressive dimness of sight, which induces frequent changes of glasses, in order to bring objects closer to the eye to obtain a larger retinal image. The vision is foggy, or the patient is annoyed by the distortion of the light or from shadows thrown upon the retina by irregularities in the opacity. Sometimes the patient finds his vision improved by concave glasses where previously convex glasses were worn; this is explained on the ground that, in the incipient stage of cataract, the lens becomes swollen and a mild form of myopia is temporarily acquired. There is rarely any pain or other disturbances complained of, in or about the eye.

Diagnosis.—When the cataract is in an incipient stage some difficulty may be experienced in diagnosing the condition, as the pupil may appear black and nothing may be observable but the amber hue of the nucleus which is seen by focal illumination; dilating the pupil, however, will probably reveal striæ or grayish streaks extending from the periphery towards the pupil, which indicate changes in the cortical substance. With the ophthalmoscope, in this case, we may be still able to distinguish the details of the fundus fairly well, if the other media are clear. As the opacity increases, the diagnosis becomes more easy, as the pupil takes on a yellowish, deep-seated haze, on which a shadow is cast by the iris on the side from which the light comes, as in Fig. 124. If now, the light is reflected into the eye with the ophthalmoscopic mirror, the centre of the pupil appears dark, while around this dark blur a circular ring of red reflex will be observed, as in Fig. 125.

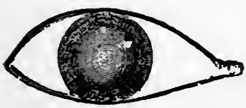


FIG. 124.

FIG. 125.

If the cortical changes are very marked the striæ will appear white or grayish, as in Fig. 122, by focal illumination, and dark or black as in Fig. 121, when the ophthalmoscope is used, and if the intervening substance is clear a red reflex with dark streaks is obtained and portions of the fundus possibly observed. If the cataract is far advanced and the opacity dense, no difficulty will be experienced in diagnosing the condition, as the pupil no longer appears dark but grayish, and the opacity will be discovered behind the pupillary space. Having diagnosed the presence of cataract we must also know the condition, whether unripe or immature, ripe or mature, or over-ripe, degenerated, or hyper-mature.

An *immature cataract* is one in which the opacity is not complete, and with focal illumination a shadow will be thrown upon the lens by the iris, showing that there is still some cortical portion of the lens between the iris and nucleus which has not become opaque and hard. The depth of this shadow will also enable us to judge of the amount of lens which still remains to be changed before the cataract becomes mature; if the shadow is very narrow, there is less lens substance to be changed than when it is broad.

A *mature cataract* is distinguished by complete opacity, the absence of any reflex from the interior of the eye when the mirror is used, and the edge of the iris appearing to lie directly upon the lens, no shadow being thrown on the cataract by the pupillary margin.

When a cataract has existed for years it degenerates and is termed *hyper-mature.* The outer layers of the cortical substance become semi-fluid and a granular mass with fat globules and cholesterine crystals is observed while the hard, yellow nucleus is found partially below the pupil in the lens capsule, and may be seen to change its position with the movements of the head. This condition has been termed *Morgagnian cataract.*

The capsule may also show degenerative changes, and, at times, deposits of calcareous matters are seen. Sometimes the lens appears of a dark brown color and there are no other

opacities present; the cataract is then called *black* or *cataracta nigra*.

In the examination of the cataract its size should also be noticed, as it has great significance, both as indicating the condition of the cataract and also having a bearing in regard to the operation. When the cataract is immature it is larger than when mature, as in the incipient stage the lens becomes more bulky from an increase of its watery elements, which are diminished as the cataract becomes ripe. Cataracts which form slowly are usually of less size than those which grow rapidly. A large cataract is usually present when the iris is pressed forward and the pupil reacts slowly, while if the surface of the iris is flat the cataract is smaller.

PROGNOSIS.—The prognosis of cataract includes the rapidity of its progress, its complications, its possible remedial relief, its removal by extraction and the subsequent prospective recovery of vision. Opacities of the lens which are developed in elderly persons increase until the whole lens substance becomes opaque, but the rate of progress varies greatly in individual cases, and depends very much upon the existence of the conditions which have primarily caused the opacity. As long as the nucleus alone is affected, the progress is very slow, and may remain stationary for a long time if the general nutrition of the eye is directly or indirectly improved. When the cortex becomes involved the progress towards complete opacity becomes more rapid, and the time consumed in the process will vary from a few months to several years. When the striæ are broad the progress is commonly more rapid than when they are narrow. It may be possible, by the observance of proper hygienic measures and the use of remedies, to stop the increase of the striæ and retain the vision of the patient for a long time. In general, the condition of the patient, as well as that of the eye, has much to do with the progress of the cataract.

When the cataract is simple, that is when there is no discoverable lesion of the eye which produces it, the prognosis as regards the vision after its extraction is, other things being

equal, extremely favorable. When the cataract is the result of other changes in the eye, or is associated with active or past diseased conditions, it becomes a *complicated cataract.* These complications may consist of inflammatory or degenerative changes in the cornea or iris, adhesion of the iris to the lens, a tremulous condition of the iris, a lessened condition of the tension, the result of fluidity of the vitreous from extensive choroidal or vitreous disease, or the tension may be increased, as glaucoma is not infrequently productive of cataract. When the cataract is complicated, the prognosis becomes more difficult in proportion to the extent of the accompanying lesions.

It is necessary to make a careful examination of the vision before prognosticating anything as regards the effect of the operation, as in simple cataract the patient should be able to recognize a lighted candle in a dark room at twenty feet or more with ease, and also be able to indicate its position when ten feet distant and held in various positions of the field. If complications exist, the quick perception of the light will be lost and portions of the field be absent, indicating retinal detachment, or the field be much contracted, the result of glaucoma or atrophy of the optic nerve. If, then, the vision is thus affected or the light perception lost, the operation for the removal of the cataract is not to be undertaken, as no chance of improving vision remains. In addition to the indications already given for a favorable prognosis in cataract extraction, we should have the cataract ripe and a pupil which responds promptly to the instillation of atropine and the patient tractable and in as good a condition as possible as regards the general health. The amount of vision attainable is dependent upon the skill of the operator, the circumstances surrounding both patient and surgeon at the time of the operation, and the care and attention given the case after the extraction. A certain percentage of cases are necessarily failures. That is, the vision is only quantitative or is entirely lost, while in the best results the patient should be able to read No. C at ten feet or have vision $\frac{1}{10}$. All degrees of vision attainable

between these two results are termed partial successes. The probable chances of a good result can only be stated by the surgeon after a full examination of the cataract and the condition of the patient.

Treatment.—When degenerative changes have occurred in the lens fibres no medical treatment will cause a return of their transparency and nothing remains to be done, beyond placing the eye and the patient in such a condition as will render the necessary surgical measures likely to give the patient vision. That lenticular opacity may occur and disappear spontaneously, or as the result of medical treatment, cannot be denied without impeaching the integrity and skill of otherwise undoubted authorities of both schools of medicine. There is no question but that in the incipient stage of cataract a great deal can be accomplished in retarding the progress of the opacity for an indefinite period of time, or even clear it up to such an extent as to make the vision entirely normal. The therapeutic means to be applied must be carefully individualized in each case, and in the selection of the homœopathic remedy we must be guided, not only by the condition of the lens or the eye, but also by the general symptoms presented by the patient, inasmuch as the malnutrition of the eye is frequently only symptomatic of a general dyscrasia. In the absence of any brilliant results from the medical treatment of cataract, and from the fact that retrograde changes can only be accomplished by continued medication for months, too little attention has been given the matter by those in our own school, who, if they would abandon the old notion of the utter impossibility of curing cataract by therapeutic means, and give their cases the close study necessary, would find that we had not yet reached the limits of the application of the law of similars. That there may be no doubt as to the results accomplished by the medication in cataract, the condition of the lens and the vision should be tested and recorded, and when the cataract is of slow progress, the vision should again be tested, after an interval of two or more weeks; if during this time there has been no change in the habits of the indi-

vidual and the vision is the same or has lessened, we are prepared to attempt the medical treatment of the cataract. If now, from time to time, we find an improvement in the vision with or without change in the appearance of the cataract, we must acknowledge that the probabilities are that the result has been obtained by the use of the remedies. If, during the time the vision diminishes and the opacity increases, we are ready to accord it a failure, then why not claim for the better result that it followed from the exhibition of the remedy?

Many cases of cataract which appear, are so far advanced, or the condition so complicated by other diseases, as to render any medical treatment useless for the purpose of improving vision; but the proper treatment of these cases will enable us during the period that must elapse before surgical measures can be adopted, to put both the eye and patient in a better condition, and thus achieve greater results from the operation, than would be possible otherwise. The remedies which have been employed with very favorable results in some cases; are Causticum, Sepia, Graph., Phos., Sulph., and Conium. Many others, as Chelid., Calc. carb., Lycop., Magnes. carb., Puls., Baryta carb., and Secale cor. have been reported as having removed lenticular cataract. Galvanism is of undoubted benefit in improving the nutrition of the eye. When the lens has become completely opaque and the cataract mature, the lens must be extracted before the vision can be improved.

Various methods for the removal of cataract are in vogue and these operations differ according to the condition of the eye and the nature of the cataract. As all cataracts are not favorable for operations we must consider, before deciding upon the operation, the condition of the eye and also that of the patient. As regards the lens, the cataract which has just reached maturity is the most favorable for operation. If the cataract is immature, the cortex is not sufficiently hard or adherent to the nucleus, and there is great danger of the separation of the cortex from the nucleus and of the cortical substance remaining in the anterior chamber where it may excite serious inflam-

mation of the iris, or tend to the destruction of the eye. If the cataract is over-ripe there will be difficulty in removing the semi-fluid substance with the nucleus, unless the lens is removed together with its capsule, and as these cases are frequently the result of inflammatory changes in the eye, they are often associated with degenerative changes which will render the result of the operation unfavorable.

The eyeball tension should be normal, the pupil properly responsive to light, the anterior chamber of normal depth and the iris present a good appearance. If the iris is sluggish, or adherent to the lens capsule, dilated, or tremulous, the conditions are much less favorable. If the tension is increased, the field of vision contracted, or light perception deficient, the surgical operation can only be attempted when, in the judgment of the surgeon, a bare chance exists, and when the patient is advised of the great probability of failure. The general condition of the patient must be improved as far as possible by proper nourishment and exercise, to prepare him for the confinement necessarily attendant upon the operation. If the patient is suffering from some cachexia, with great depression of vitality, the operation is contra-indicated.

If any conjunctival or lachrymal trouble exists, it must be cured before the operation can be undertaken. Whether one eye should be operated upon while the other is yet unaffected or fair vision retained, will depend upon the circumstances of individual cases. As a rule in senile cataract it is better not to do so, unless a favorable result is almost certain. When both eyes are blind, it is better to operate upon one first, and not upon the other for at least two months afterwards. For if one alone is operated upon and the result is not satisfactory, the modification or change in the method of extraction may enable us to attain a good success in the second eye, which might have participated in the failure of the first had the operation been performed upon both at the same time.

OPERATIONS FOR SENILE CATARACT.

Of the variety of operations performed for cataract extraction those which require consideration here are the old flap

operation, the modified linear of Von Graefe, and those of Le Brun and Liebrich. The relation of the different incisions to the cornea will be understood by reference to Fig. 126 which shows that of the flap operation, Fig. 127 that of Von Graefe, and Fig. 128 that of Le Brun above and Liebrich's below.

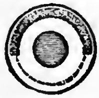


FIG. 126.

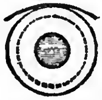


FIG. 127.

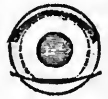


FIG. 128.

The Flap Operation deserves but a passing notice as it has become obsolete. The extraction of the cataract was made through a large wound in the cornea, made by a Beer's knife, without interference with the pupil beyond that which was occasioned from the stretching of the iris during the passage of the lens over it. Tho results when the operation was successful were brilliant, but the danger of suppuration from so large a wound in the cornea has resulted in the abandonment of it for safer methods.

The Reclination of Cataract has passed to deserved oblivion, from the fact that the displacement of the lens into the vitreous, where it acts as a foreign body, sooner or later destroys the eye, or causes sympathetic disturbance of the other. The operation consists in the introduction of a cataract needle about a line and a half from the cornea in the outer and lower portion of the sclera; the needle is then pushed upward and forward until it rests upon the upper part of the lens which is then dislocated and pressed slightly downward until it rests in the vitreous. The immediate effect of the operation is brilliant, but the after dangers are too great to allow of its performance except in very rare cases. I have never made the operation but once, and then in a patient who had but a few months to live, and to whom it gave the pleasure of vision while life lasted.

MODIFIED LINEAR EXTRACTION.

The modified linear extraction (Fig. 129) was first practised by Graefe in 1865. The danger of suppuration of the large corneal wound of the flap operation is avoided by making an

incision slightly in the sclera when a smaller incision will suffice for the escape of the lens. The bruising of the iris and its subsequent inflammation is largely avoided by the combination of an iridectomy with the operation. The modified linear operation as now made by most operators differs in some minor particulars from that originally made by Graefe.

The incision is made nearer to the cornea or in the sclero-corneal junction and increased in length. The danger of loss

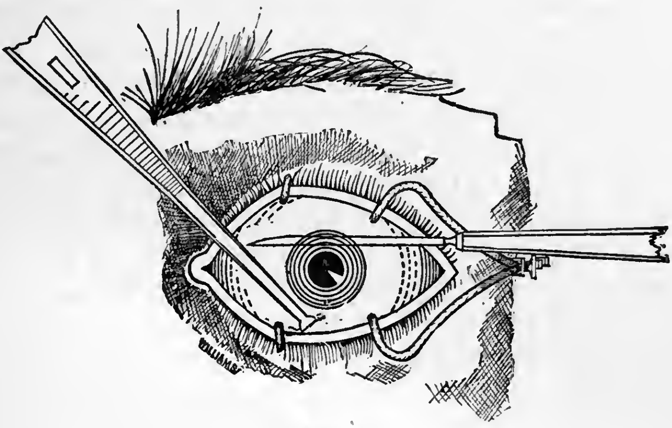


FIG. 129.

of vitreous and the wounding of the ciliary processes and subsequent cyclitis is thus lessened. Improvements have also been made in the methods of opening the capsule.

The operation is divided into four stages: first, the corneal incision; second, the iridectomy; third, the laceration of the capsule; and fourth, the delivery of the lens.

The patient should be put in as good a condition as possible prior to the operation and a good night's rest secured. The rectum should be emptied a few hours before the operation.

An anæsthetic can be used or not according to the judgment of the operator and the ability of the patient to sustain the pain. In the majority of cases, it will be found advisable to use it, as the eye can then be perfectly controlled and all muscular contraction is avoided, while the shock of the operation and the attendant nervous excitement is much lessened.

Its use is only contra-indicated by the struggling and its attendant congestion of the head, and the probability of vomiting either during or after the operation. Yet I am inclined to think that ill results from such causes are rather rare, if the extraction has been properly performed and the eye well bandaged afterward.

The iridectomy which forms the second stage of the operation may be made at the time of the extraction, or some weeks previous, when it is termed a *preliminary iridectomy;* that it has its advantages is now conceded by all operators. As a rule, it is not necessary to give an anæsthetic for the performance of the iridectomy, but from the behavior of your patient during this operation, you are able to determine the necessity of anæsthesia during the extraction. Again, there are further points to be gained by making a preliminary iridectomy. You are able to judge of the condition of the cornea and thus decide upon the proper incision for the individual case, of the irritability of the eye from operations, the ability of the patient to bear the confinement necessary after an operation, and finally of his tendency to that low grade of conjunctivitis which frequently retards recovery in this class of patients. If, on the other hand, the iridectomy is made at the time of the extraction, we have the large fresh wound of the iris corresponding to the line of the incision in the cornea, and in this the amount of injury to the eyeball is much increased, and the dangers from traumatism correspondingly greater. Moreover, the hemorrhage from the cut iris is oftentimes very annoying, and not infrequently complicates the operation by obscuring the lens to such an extent as to severely impede the operation. Again, during the process of removing the lens, the cut edges of the iris are more liable to be bruised, and we are apt to have a local, if not general, inflammation of the iris, which will cause adhesion to the lens capsule, or inflammation and consequent opacity of the capsule itself.

These, then, are some of the advantages to be gained by separating the two operations. The objection against this method of procedure is the fact that patients coming from a

distance must either remain during the interim separating the operations, or return again for the second one. This is quite an obstacle to some patients, and where it cannot be overcome by the statement that the prospects of vision are much better from the division of the operation, it will be necessary to combine them.

The iridectomy should be made upward, in the usual manner, with an angular keratome and about one-sixth of the iris removed. After the operation a bandage is applied, and the patient confined to bed. A few hours afterward, or the next morning, when the bandage is reapplied, atropine is to be instilled to prevent adhesions of the iris. There is usually no reaction, and in three or four days the patient is allowed to go about as before.

When the extraction is made by the modified linear method the following instruments are necessary: a speculum for holding the lids widely apart, a pair of fixation forceps to steady the eyeball, a linear cataract knife, narrow and sharp, a pair of iris forceps and scissors, a cystotome and a lens scoop of hard rubber.

The patient is placed in a recumbent position before a good light, ether administered and full anæsthesia produced before any attempt is made to proceed. The operator, if he uses the

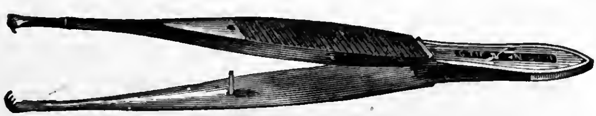


FIG. 130.

right hand, stands behind the head of the patient for the right eye, and at the left side for the left. The lids are then separated by the speculum, or the upper lid raised by an elevator or the finger of an assistant. The *first stage* of the operation is now begun. With the fixation forceps (Fig. 130), the operator seizes the conjunctiva below the cornea and makes his incision with the linear knife (Fig. 131), the point of which must be entered on the temporal side, exactly in the sclero-corneal junction and directed towards the centre of the

pupil; having arrived there, the point must be raised and carried across the anterior chamber, close in front of the iris, and made to emerge through the corneo-scleral ring at a point on a level with that of the entrance; with a slight sawing motion, the blade should now be made to cut its way out, keeping precisely in the corneo-scleral junction to the last,

FIG. 131.

when the edge should be turned to the front to cut through the conjunctiva, of which a short flap should be left attached to the cornea. At this stage, the cornea may collapse or blood may fill the anterior chamber. In the latter case, the lid must be dropped for a few moments and cold water applied; when the hemorrhage has ceased, the blood may be pressed out of

FIG. 132.

the eye by gently wiping the wound with a bit of soft muslin, while the upper edge of the incision is slightly pressed backward by the hard rubber spoon (Fig. 132).

The *second stage* in the operation is the iridectomy; this is intended to enable the lens to escape more easily, and also to prevent the prolapse of the iris in the wound, which would tend to prevent healing, or become a source of irritation to

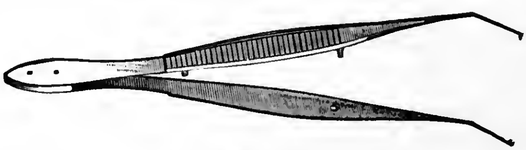


FIG. 133.

the eye. It is not necessary to remove a large portion of the membrane. The fixation forceps are now held by the assistant while the operator turns back the conjunctival flap with the closed iris forceps (Fig. 133), and if the iris presents itself at the centre of the wound, it is seized by the forceps, or if not, the forceps are introduced into the anterior chamber and the membrane caught near its pupillary margin, drawn out,

and a piece about 5 mm. wide excised close to the sclerotic, with the iris scissors (Fig. 134).

The *third stage* of the operation is the incision of the capsule; this is done by introducing either a Graefe (Fig. 135), or Knapp's cystotome into the anterior chamber, just behind the border of the iris, at the lower edge of the pupil,

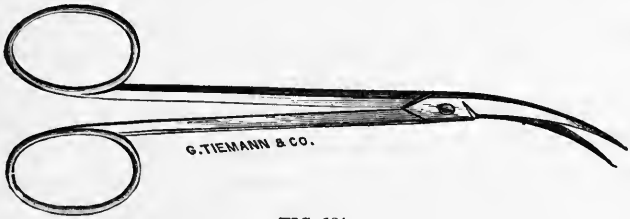


FIG. 134.

and making a clean curved incision in the capsule parallel to the incision in the cornea. Various other methods of incising the capsule have been proposed, either by numerous cuts, or by a circular incision, which would remove the central portion of the capsule. The cystotome is made with a malleable shank so that it can be bent to suit the brow of either eye.

The *fourth stage:* The edge of the lens may now be made to present its edge externally by pressing gently with the spoon at the lower margin of the cornea; as the lens advances into

FIG. 135.

the wound the spoon follows it up over the surface of the cornea and receives it as it escapes from the eye. If any cortex remains, it may generally be brought into the pupil by a gentle, circular, rubbing motion of the lids, and may be pushed out of the anterior chamber by pressure upon the lower lid, while the upper lid is slightly raised and with slight pressure depresses the upper lip of the wound. If the lens does not readily present itself in the wound the capsule should be again incised, or if the lens presents, but does not readily escape, the corneo-scleral wound should be again enlarged with the scissors.

It is at this period of the operation that there is the greatest danger of the escape of the vitreous; if it is small in amount, it is of no particular consequence, but a great loss may be followed by hemorrhage of the choroid or final shrinking of the ball. If the prolapse of the vitreous occurs before the escape of the lens, the latter should be removed by means of a wire loop (Fig. 136); afterwards a pressure bandage should be applied as quickly as possible.

It happens in the majority of cases that, after the nucleus has escaped, a portion of the softened cortex remains. This should be removed by a gentle rotary motion of the finger upon the closed eyelid, or by pushing the lower lid upwards towards the wound. If this is not sufficient, gentle pressure

FIG. 136.

may be made upon the lower portion of the cornea by the hard rubber scoop, when the remaining portions will pass out. The wound is to be thoroughly cleared by the forceps of any prolapse of the iris, lens substance, or clot, and it should be observed whether there is an accurate approximation of the lips of the wound. The conjunctival sac should be cleansed with a weak boracic acid solution, and a compress bandage applied to both eyes.

The *after treatment* consists in the confinement of the patient to bed, in a dark room, and the dressings made by candle light. The patient should take that position in bed, upon the back or side, which may be most comfortable to him, and which can be maintained for at least ten hours without change. No muscular effort whatever is to be made, and the food must be liquid so as to avoid chewing motions, but should be nutritious, as the strength of the patient needs sustaining. If all has gone well, there is no pain beyond a little smarting, or an occasional twinge from the accumulation of tears between the eyelids, which is relieved as the tears are felt to pass down the cheek. If possible, sleep should be obtained during the first night following the operation, as absolute quiet is of much

greater value at this stage of the treatment than at any time later. The bandage may be reapplied eight or ten hours after the operation, if the eye is uncomfortable, but the eye should not be opened. If there is no discomfort, the bandage need not be disturbed for twenty-four hours. The nature of the discharge upon a bit of muslin covering the eye and the condition of the lids will indicate the progress of the case. If there has been no pain and the secretion is of mucus and scanty, the indications are good. If there is pain, iritis is to be feared and atropine should be thoroughly used. If the lid becomes puffy and the discharge increases, the danger of suppuration of the wound is imminent, and it may be necessary to use hot fomentations of calendula lotion and stimulate the patient.

If no complications arise after the second day, a drop of atropine solution is to be put into the eye night and morning when the dressings are changed. After a week or ten days, the patient may be allowed to sit up, and after this, the light should be gradually admitted to the room and the patient provided with a shade; usually, two or three weeks are required for the after treatment. In about a month or six weeks, if all irritation has disappeared from the eye, glasses may be worn.

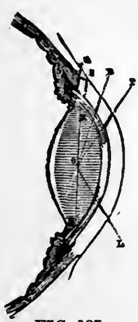


FIG. 137.

The operations of Liebrich and Le Brun have recently come into vogue. In both, the section lies in the cornea and the operation is performed with a somewhat broader linear knife and without an iridectomy. In Le Brun's, the incision is made in the upper portion of the cornea by entering the knife 2 mm. in the sclera and bringing it out at a point opposite and cutting directly outward, so that the incision ends in the cornea slightly above the pupil.

The directions of the different incisions are given in Fig. 137, *G* showing the place where the Graefe original incision is made, *S* where it is now generally made, *D* the place of section of Liebrich when it is made in the upper section, *L* in the upper portion is the section of Le Brun, and *L* that of

Liebrich, when the incision is made in the lower section of the cornea.

The modified Liebrich operation forms an easier method of extraction than that of the modified linear and the results are oftentimes better. A preliminary iridectomy should be made and the incision laid in the upper portion of the cornea; the point of a linear cataract knife broader than the Graefe is entered in the sclera about 1 mm. from its border at the upper third and carried directly across the anterior chamber and brought out at a corresponding point opposite. The incision is completed by passing with a slight curve through the cornea, so that the centre of the incision lies on the cornea midway between the edge of the pupil and the periphery of the iris. The balance of the operation and the after treatment are the same as that described for the modified linear.

Operations for the removal of the lens in its capsule have been devised and perfected by Paganstecher and others, and are suitable in some cases, as in the Morgagnian cataract. But these operations necessitate the introduction of a scoop or other instruments into the eye and are apt to be attended by extensive loss of vitreous or traction upon the ciliary body to the imminent danger of the eye.

CAPSULAR CATARACT.

Opacities of the lens capsule are rare, and result from the deposits of neoplastic masses upon its anterior surface, during an iritis, keratitis, or perforation of the cornea, forming *anterior polar* or *pyramidal cataracts*. When occurring upon the posterior portion of the capsule they are called *posterior polar cataracts* and are seldom visible without careful focal illumination when they present either a patchy or stellate appearance as in Fig. 138 and arise from inflammatory affections of the deeper structures of the eye.

FIG. 138.

These capsular opacities are rarely amenable to treatment, but may be stationary and interfere but slightly with vision if not extensive or central.

Secondary or Membraneous Cataract is a variety of capsular cataract which may follow cataract extraction. Opacities form in the pupil some time, often months, after the removal of the lens. It may be filmy, like a delicate cobweb, which can only be detected by oblique illumination, or appear as a white membrane in the pupil. It is due to the proliferation of the cells of the capsular tissue, or results from iritic inflammation, and the iris is often adherent to it.

The methods generally preferred are to tear an opening in the centre of the opacity by means of two needles introduced in the same manner as described for discission. The utmost gentleness must be exercised as the slightest traction upon the tough membrane is often sufficient to cause a cyclitis which may leave the eye in a worse condition than before. If the membrane is very tough the operation of iridotomy (see page 289) is often more practical.

APHAKIA.

Aphakia or the absence of the lens may, in rare cases, be a congenital condition. In the acquired form, it is the result of the removal of the lens, as after cataract operations. It requires a strong convex glass from $+ 4\frac{1}{2}$ to $+ 4$ for distant vision, depending upon the original refractive condition of the eye. As the power of accommodation is also lost with the removal of the lens, a stronger glass, usually $+ 3\frac{1}{2}$ to $+ 3$, will be required for near vision. Astigmatism is often present in these cases and its correction by combined sphero-cylindrical glasses oftentimes adds much to the vision of the patient.

LUXATIO LENTIS.

Dislocation of the lens may be congenital or result from injury. In these cases the iris is tremulous, and the edge of the lens may be seen in the pupil with the ophthalmoscope,

appearing as a dark curved line on the red background of the fundus. If the displacement is congenital, the lens remains clear and operative interference is not indicated. The vision may sometimes be improved by the use of a proper convex glass.

If the lens is loose and acts as a foreign body, it should be removed at once and inflammation averted. The incision is made as for cataract extraction and a wire or fenestrated scoop is introduced behind the lens and the lens removed in its capsule. The procedure may be facilitated by introducing a needle through the cornea and passed behind the lens so that the lens is held in position, while the scoop is introduced and the lens removed upon the scoop. When the lens is dislocated beneath the conjunctiva, it should not be disturbed until the sclero-corneal rupture is healed, when it is easily removed by an incision through the conjunctiva.

CHAPTER XVII.

DISEASES OF THE VITREOUS.

ANATOMY.

The vitreous body is a transparent, gelatinous mass occupying the larger portion of the interior of the eye, about four-fifths, through which the light passes to reach the retina. It forms a support for the delicate structures of the retina, from which it is separable except about the optic nerve entrance. Its anterior portion is hollowed for the lens and its capsule to which it is adherent. The vitreous is inclosed throughout, except in front, by a thin glassy membrane, the hyaloidea. It has no blood-vessels in its structure in adult life, being dependent upon the vascular supply of the retina and choroid for its nutrition. Although presenting no structural elements in the fresh condition, when hardened it appears to be divided into concentric segments by minute prolongations of the hyaloidea, which also give out a radial striation around the optic nerve entrance. At the posterior surface of the lens certain cellular elements, which appear to be white blood corpuscles with amœboid movements, are found; other cells of stellate shape have also been described by some authorities. Between the optic nerve disc and the posterior surface of the lens is also a minute canal which in the fœtus carries the hyaloid artery, derived from the central artery of the retina and which carries forward the nourishment to the lens during its development. In rare cases this artery persists in life.

The hyaloid membrane, at the anterior portion of the vitreous becomes firmer, is closely attached to the ciliary body, and is known as the zonule of Zinn, which presents a distinct fibrous structure. The fluid of the vitreous body consists of water containing some albuminate of soda and a little mucin.

DISEASES OF THE VITREOUS.

Disease of the vitreous occurs very rarely as a simple affection, except as the result of senile degeneration, as it presents little evidence of organized structure, but as its nutrient elements are derived from the ciliary body, choroid and retina, it often participates in the inflammatory diseases of these tissues, and hence may also be the seat of acute or chronic inflammation which affects these structures. The morbid changes are more commonly those which result from variations in the density of its structure, and the presence of opacities, fixed or floating and of varying size.

HYALITIS.

Inflammation of the vitreous is characterized by the migration of white blood corpuscles and their proliferation and these changes are often readily observed by the ophthalmoscope, when the anterior portions of the vitreous are transparent. Hyalitis may be serous, plastic, or suppurative, according to the nature of the inflammatory exudation of the neighboring tissues which have involved the vitreous.

Causes.—In addition to the causes already enumerated, hyalitis occurs as the result of blows, wounds of the more posterior portions of the globe, and the penetration and lodgment of foreign bodies in the eye.

Symptoms.—Any affection of the vitreous is known only by its effect in causing it to become turbid and fluid, thus impairing the vision. This turbidity results from the infiltration and proliferation of the cell elements which may also form opaque, membranous masses. These may be either floating

or stationary, and if sufficiently large are readily seen with the opthalmoscope in the direct method, when the mirror is held a few inches from the eye and the patient directed to turn the eye rapidly in various directions, which gives the opacity motion and it will be discovered as it slowly floats past the area behind the pupil.

TREATMENT.—The treatment should be directed to the cause and for the indications of remedies useful, reference should be made to those given for the inflammatory diseases of the iris, ciliary body, and choroid.

OPACITIES OF THE VITREOUS.

The vitreous body is not absolutely transparent, for in most healthy eyes dark bodies may be seen on looking through a pin hole in a card, in a bright light, or at a white wall or cloud. These motes, or *muscæ volitantes* appear in various forms floating about in the field of vision. They seem to the patient to consist of minute bead-like masses which are strung together in various shapes, or of delicate filaments having a webby appearance, and seem to ascend from the lower part of the field of vision and then fall down again, or when the attempt is made to watch them, they pass out of sight only to return when some near object is regarded. As they seem to retain the same relative distance from the visual axis, they are often annoying, but do not interfere with the distinctness of vision. These various appearances are due to the presence of minute cells in some portions of the vitreous, which intercept the light rays and cause shadows to be thrown upon the retina. The number of these cells is often greatly increased by over-work of the eyes at near objects, from derangement of the digestive organs, and in myopia. In the latter disease they become very annoying, from the fact that the shadows cast by them are often better defined than external objects. When they become very troublesome in nearsighted persons, they are an indication of the progressive condition of the myopia. It seems to be the result of immoderate tea drinking in many

cases, which produces digestive derangement and thus affects the eye secondarily. Such opacities as these are always too minute to be seen with the ophthalmoscope.

Treatment. — When occurring in myopia, they may be greatly dissipated by the use of a properly adapted concave glass which by making the vision more distinct, tends to diminish their effect. When caused by too close work of the eyes, rest must be prescribed, and when connected with digestive troubles these must be corrected. There are none of our remedies which are specially indicated for this condition, but when used for the primary disease which is the exciting cause, they are frequently dispelled. When immoderate tea-drinking is probably the cause, abstinence should be practiced, or the consumption of tea much lessened and more food taken.

Opacities of the Vitreous. — The vitreous, which is of firmer consistency in its outer portion than in the more central parts, becomes in old age more liquid, from the fatty degeneration of its elements. This condition, or *synchisis*, results also from inflammatory affections of the choroid and causes lessening of the tension of the eye, while the vitreous contains floating opacities which are observable both objectively and subjectively. In some cases of fluidity of the vitreous, called *synchisis scintillans*, numerous floating crystals of cholesterine are present, which, in an ophthalmoscopic examination, reflect the light and glitter like minute specks of gold, which rapidly move through the vitreous on motion of the eyeball.

Opacities of the vitreous may vary in degree from a diffuse cloudiness to a dense mass which obstructs all view of the optic disc or fundus.

Causes.—This condition may be due to any inflammatory condition, particularly syphilitic, of the interior structures, which causes an hyper-secretion of serous fluid into the vitreous chamber. As the primary disease subsides, the vitreous may gradually clear and become transparent, or opacities of greater or less extent remain. When these opacities are movable, or floating, they indicate a fluid condition of the vitreous.

SYMPTOMS.—These opacities may interfere very seriously with the vision, if they lie in the visual axis, or may occasion no inconvenience when out of the line of vision and may be overlooked by the observer in an ordinary ophthalmoscopic examination.

DIAGNOSIS.—With the ophthalmoscope, in the direct method, these opacities, if not too minute or the vitreous turbid, may be readily distinguished by using a proper correcting glass for the fundus when the opacity is situated near the retina, while if near the centre of the eye a convex 8 will be required, and when more anterior even a convex 4 or 5 will be necessary. A weak illumination should be used and the patient directed to move the eye rapidly in various ways so as to give direction to the floating body, which soon comes in view behind the pupil.

TREATMENT.—In general the continuation of the remedies which have been used for the productive cause of the opacities are still indicated; such remedies as Kali iod., Kali mur., Hepar, Gels., Phos., and Lachesis will prove more useful than others for this purpose. In cases of opacities from effusion into the vitreous, the patient should give up any occupation which tends to produce congestion of the eyes or head. In filmy opacities of the vitreous which seem to involve a considerable extent of it, improvement of vision may possibly be gained by tearing the filaments by the introduction of needles through the sclera and thus separating the opacity in the line of vision.

HEMORRHAGE INTO THE VITREOUS is caused by rupture of the vessels of the retina or choroid, usually the latter, and may arise spontaneously during inflammatory diseases of its tissues or from injuries to the globe. It is usually accompanied by localized detachment of the retina. A hemorrhagic opacity, unless very small, is not observable with the ophthalmoscope, as it more frequently fills the vitreous and prevents the light from entering the interior, and nothing but a dark reflex is obtainable; with oblique illumination a dark red appearance behind the pupil may be obtained. Sometimes the effused blood settles down as a coagulum in the bottom of the

eye. The vision is naturally greatly impaired and the patient complains of a red cloud before the eyes; this, together with the sudden onset of the blindness, which may occur within half an hour, will render the diagnosis easy. As already stated, it is often accompanied by detachment of the retina, and the patient must be examined according to the directions given in injuries of the vitreous in the chapter on Injuries of the Eye, to detect it and determine its extent, as this will affect the prognosis.

The blood is absorbed more readily though gradually when it comes from the more anterior portions of the choroid or ciliary body. Weeks, however, are required to cause a sufficient clearing up to allow of a partial return of vision.

After hemorrhages, black threads or filaments remain either permanently, or for a long time, and may seriously interfere with vision, or when a coagulum forms the resulting contraction may result in detachment of the retina.

Treatment.—When due to injuries, ice compresses and rest in bed are necessary for the first two or three days and the administration of Arnica, Bell., Hamamelis and Lachesis will be useful. In hemorrhage arising from any cause it is better to confine the patient to bed for ten days or two weeks and bandage the eyes.

Cysticercus is a parasite which may also be found in other portions of the eye. While more common in Europe it occurs very rarely in this country; it is sometimes observed beneath the retina, or in the vitreous, and requires usually the enucleation of the eye. It appears as a bluish-white cyst, which increases rapidly in size and induces inflammatory changes.

Persistent Hyaloid Artery is a rare condition which results from the artery which is destined to supply nourishment to the lens during fœtal life remaining in extra-uterine life. It appears as a dark line extending from the posterior surface of the lens to the optic disc. Occasionally other blood vessels appear in the vitreous from the development of membranous masses or as prolongations of retinal vessels, and may disappear or become permanent.

CHAPTER XVIII.

DISEASES OF THE CHOROID

ANATOMY.

The choroid is essentially the nutrient membrane for the interior structures of the eyeball and consists of two layers of blood-vessels held in position by a stroma of connective tissue. It extends from the optic nerve entrance, around which it forms a ring, nearly to the sclero-corneal junction, where it ends in a series of folds or plaits, the ciliary processes, which, together with the ciliary muscle, form the ciliary body. Between the outer surface of the choroid and the sclera, a lymph space is found in the large-meshed connective tissue which exists between these two membranes, except about the optic nerve entrance where they are closely united. This lymph space is held to be in direct communication with that of the capsule of Tenon and the other lymph spaces of the eyeball, and also with the different portions of the choroid. In the choroid four layers are described which are separated by endothelial cells which also envelop the blood-vessels.

Of these layers, the most external has been termed the lamina supra-choroidea, a membranous layer similar to the lamina fusca of the sclera, to which it is united by connective tissue meshes holding pigment cells, and to the whole choroid by endothelial cells, thus forming a lymph space. The next layer, the tunica vasculosa, or layer of large blood-vessels, presents the major portion of the stroma of the choroid, which consists of striated fibre cells (*b* Fig. 139) and pigment cells

(*a* Fig. 139) of various forms uniting the elements of the choroid together. The third layer, or chorio-capillaris, is continuous with the meshes of the stroma with finer cells, and contains the capillary divisions of the arteries and veins of the tunica vasculosa. The remaining layer is the lamina vitrea or elastica, a structureless, or finely fibrillated, transparent membrane covering the layer of capillary vessels and upon which rests the layer of hexagonal pigment cells of the retina. Through the stroma of the choroid and along its vessels are found smooth, unstriated muscular fibres which, in the human eye, are regarded as rudimentary.

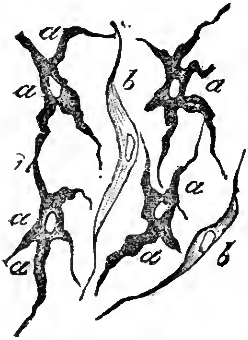


FIG. 139.

The arteries of the choroid are derived from the anterior and long ciliary arteries which send recurrent branches, and from the short ciliary arteries which are lost in the capillary layer after numerous subdivisions. The veins beginning as capillaries in the chorio-capillaris, take in the tunica vasculosa a whorl-like form and uniting into large trunks, constitute the venæ vorticosæ (*v* Fig 140), which are four to six in number, and pass obliquely through the sclera in the equatorial region of the eye to empty into the ophthalmic vein; a·small portion of the blood from the anterior portion of the choroid being returned through the anterior ciliary veins.

FIG. 140.

The nerves of the choroid are very numerous and are derived from the third, fifth and sympathetic through the long and short ciliary nerves and form in the choroid fine plexuses of nerves with many ganglionic cells.

DISEASES OF THE CHOROID.

The choroid being the most vascular part of the eye, except the ciliary body, and being related by continuity of structure

with the ciliary body and through it with the iris, as we have already seen, is very prone to participate in the inflammatory action of those more anterior structures of the eye. As the outer layers of the retina and the greater portions of the vitreous derive their nourishment from the choroid, we find it intimately related to the various other portions of the globe, either directly or indirectly, and hence likely to be implicated in the diseases of these structures; or, diseases of the choroid may result in changes in the retina, vitreous, lens or still more remote portions of the eyeball.

According to the nature of the exudation, inflammation of the choroid is termed serous, plastic or purulent. As the choroid is a delicate tissue, consisting of a large number of blood-vessels and held together by a rather loose stroma, which rapidly becomes saturated with the products of inflammation when these are thrown out in large quantity, and as the sclera from its density offers considerable resistance to infiltration of its tissue, the copious exudation tends towards the interior of the eye, saturating and passing through the retina to the vitreous, from which it may pass forward and reach the aqueous. As the pigment layer of the retina lies upon the choroid, diseases of the latter cause changes in the pigment epithelium which may result in its absorption, proliferation or a crowding together of its cells in masses.

Causes.—Choroiditis is generally due to inherited or acquired syphilis, and appears usually at a more or less remote period after the primary and secondary stages have passed. It also results from injuries to the eye, occasionally arising idiopathically as the result of a low state of the system or as a sequel of severe constitutional diseases and after severe mental shock. Highly myopic eyes show a predisposition to choroiditis which may follow slight provocation.

Symptoms.—Inflammation of the choroid, unlike diseases of its continuations, the iris and ciliary body, is seldom attended by external congestion, pain, heat or lachrymation. The vision may be either seriously or only slightly impaired, the visual defect depending upon the extent and nature of the choroidal

affection, as well as upon the location of the lesion, and also upon the disturbances of the vitreous.

DIAGNOSIS.—As the subjective symptoms are not pathognomonic of the disease, the diagnosis rests almost wholly upon the ophthalmoscopic appearances. If the anterior portions of the eye are transparent and the vitreous clear, we shall be able to discover any changes in the choroid without difficulty. As the pigment layer of the retina commonly participates in the choroidal lesions, it is often very difficult to determine whether the choroid or the retina has been the seat of the primary affection, as the pigmentary changes are as frequently the result of retinitis or hemorrhage, as of choroidal trouble. The ophthalmoscopic changes usually met with are those which indicate atrophy of the choroid. These may be partial or complete, and occur in circumscribed spots of varying size. These spots are paler in color than the normal choroid or may be perfectly white, from complete atrophy of the choroid at the point of lesion, so that the underlying sclera shines through. These patches may be surrounded by aggregations of the pigment epithelium which form black borders of varying width and thickness, or the pigment itself is accumulated in spots, patches, or masses in the retina or choroid, without the atrophic appearances of the choroid. A few scattered and small spots of pigment on the choroid, or in the retina, often indicate former hemorrhages when there are no evidences of atrophy of the choroid.

HYPERÆMIA OF THE CHOROID.—Acute congestion of the choroid occurs frequently in connection with other inflammatory diseases of the eye. Chronic congestion may appear independently, as in myopia, or from prolonged exposure to bright lights and great heat, as in men who are employed in rolling mills. It is almost impossible to demonstrate the condition with the opthalmoscope unless it exists in only one eye, or from the variations in tint of the fundus which may be observed to occur at different times in the same eye.

Treatment.—When the condition is inferred, the eye should be protected by dark glasses from all bright lights and Bell., Phos. or Puls. administered internally.

Anæmia of the Choroid.—In conditions of extreme anæmia the choroid becomes of a pale and yellowish hue, but requires no special treatment beyond that indicated for the general anæmic condition.

Choroiditis Serosa occurs rarely except as an extension of serous inflammation of the iris or ciliary body, the most frequent form being that of Irido-choroiditis (Plate IV, Fig. 4.) A thin, serous fluid is secreted, usually in large quantity, and percolates through the choroid and retina into the vitreous, which becomes greater in quantity and clouded and the tension of the eyeball markedly increased. The anterior chamber appears more shallow and the lens and iris pushed forward. If the tension remains plus for any length of time, the retina and optic nerve suffer from compression and the vision is destroyed. When the process is acute, it is accompanied by photophobia, severe pain, fever and rapid diminution of the vision with marked increase of the tension, and has been termed acute inflammatory glaucoma, or *glaucoma fulminans*, from the suddenness of the attack.

The condition is usually more chronic and there is, often, little pain, slight photophobia and only temporary increase of tension with variable vision. At times the vitreous clears up and an opthalmoscopic examination is possible, when the retina will appear hazy or grayish and the retinal vessels, particularly the veins, appear congested and tortuous.

Causes.—The disease occurs usually as a complication of serous iritis, or in eyes that show extensive posterior synechia, or occlusion or exclusion of the pupil, and in cases where the lens has been injured or dislocated into the vitreous. The more chronic condition occurs, not infrequently, in syphilitic patients with or without posterior synechia.

Treatment.—The cause must receive due consideration and the tension be carefully watched. Complete rest of the eyes must be enjoined and they should be protected from the light by smoke-tinted glasses, or in acute cases the eyes should be bandaged and the patient confined to bed. If there is much increase of tension, eserine solution, locally, may be of much

benefit, or it may be necessary to make a broad iridectomy to prevent destruction of the vision. Much may be expected from our remedies in this affection and the prompt use of Gelsemium, Bryonia, Phos., or Jaborandi will, when indicated, give brilliant results and prevent the necessity of operative interference.

CHOROIDITIS PLASTICA is characterized by the exudation into portions of the choroid of a plastic material consisting of a fibrinous substance with numerous round cells. These masses of exudation appear as round or oval masses in the stroma of the choroid, or extend into the retina. It may be either acute or chronic. When acute the iris is usually affected, and there is pain, ciliary injection and diminution of vision. The vitreous is at first cloudy, but as it becomes clear the ophthalmoscope reveals patches of whitish exudation of varying size which, from the fact that the retinal vessels are observed to pass over them, are seen to be located in the choroid. The retina may be implicated and the vessels partially hidden by the serous infiltration, and the optic papilla may also be swollen. In other cases as the disease progresses the pigment layer is disturbed and irregular black patches appear in the spots, or surround them as with a wall.

In the majority of cases the condition is more chronic and advice is sought because of the failing vision, and the diagnosis depends entirely upon the ophthalmoscope. On examination large patches of the choroid will be found to be atrophied, particularly in the posterior portion, or often all stages of the disease will be seen, from the primary deposits of exudation or of pigment in some portion of the fundus, while in others atrophic spots, with thinning of the retinal pigment and absorption of the choroidal stroma will appear, or the whole choroid will present an atrophic condition, and, if the retina has been involved, the optic disc is atrophied and the retinal vessels are diminished and lessened in calibre while the fundus exhibits floating opacities which mark its fluidity. For clinical purposes two varieties are described, namely, choroiditis disseminata and choroiditis areolaris; when the retina is implicated, the disease is termed chorio-retinitis.

Choroiditis Disseminata (Fig. 141) is a variety of plastic choroiditis. In this variety, all of the patches or exudations are smaller than the area of the optic disc and are scattered through the otherwise healthy choroid, although several spots may coalesce and form large areas.

All stages of the disease are frequently present in the eye at the same time, and the spots appear black, red, or white according as the pigment, choroidal stroma, or sclera are observed. When the patches are white, there is always a border of pigment surrounding them. Both eyes are apt to be attacked but not to the same extent; frequently we find the disease existing only in one.

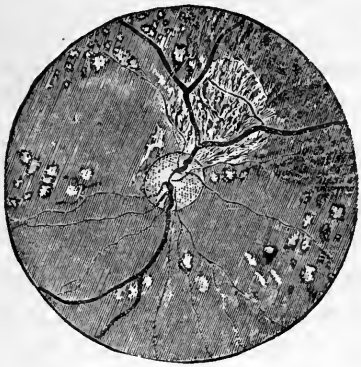


FIG. 141.

Causes.—The disease may be congenital or appear in young persons. When appearing in adults, it is often indicative of syphilis and has been termed *syphilitic choroiditis.* The choroidal affection generally occurs from one to three years after the primary disease, whether it is inherited or acquired. It is, however, not necessarily an indication of syphilis, as it undoubtedly arises from other causes, as those mentioned under the general causes of choroiditis.

Symptoms.—The principal symptom is more or less loss of vision. Pain and injection of the eye are commonly absent. If only one eye is affected, the disease may be far advanced before aid is sought, but if the other eye becomes involved, the loss of vision is such as to cause immediate attention to the eyes.

Disturbance of the retinal elements by the exudation in the choroid pressing upon or crowding the layer of rods and cones causes *metamorphopsia, micropsia, or megalopsia.* If the choroidal inflammation affects the macula lutea, there is complete loss of central vision, while, if the peripheral portions

23

only are affected, the central vision may be but slightly impaired. Syphilitic choroiditis generally gives rise at an early date to opacities in the vitreous; these may be of large size and readily seen, or so minute and numerous as to cause a general diffused haziness. Sometimes, in syphilitic cases, the whole fundus will be studded with minute dots of exudation in the choroid, the vision be much affected, the vitreous hazy, and after a time clear up and leave no evidence of the disease.

Prognosis.—The disease is very apt to be chronic in its course and may continue for months. In all cases the vision is permanently impaired, and the acuteness diminished according to the extent in which the macula lutea and the more central portions of the choroid are involved. Posterior polar cataract is sometimes developed in the advanced stage and serious opacities of the vitreous remain.

Treatment.—It is well to prescribe, in addition to the internal remedies, rest of the eyes and their protection from bright lights by the use of smoke-colored glasses. Confinement to bed, or a darkened room, is rarely necessary. Stimulants and the use of tobacco should be avoided in all cases. When the disease has passed into the stage of atrophy, nothing can be done beyond the prescription of slightly tinted glasses to relieve the glare arising from the reflection of the light from the sclera when the spots are large. The remedies which will be indicated are Kali iod., Merc. cor., Aurum mur., Bell., Phos., Nux vom., Kali mur., and Sulph.

Choroiditis Areolaris.—This form of choroiditis is very similar to that just described and the pathological changes are the same, but in addition there is a hyperæmia of the optic disc, a haziness of the retina around the disc and exudation along the retinal vessels, particularly the veins. The patches of choroidal change are large or small, and in different portions of the fundus, as in the disseminate form. There is, however, sudden and frequent clouding of the vitreous and tendency to constant relapses. The disease is syphilitic and occurs in the later stages of the constitutional trouble.

Treatment is the same as that for disseminate choroiditis.

Choroiditis Suppurativa — Panophthalmitis.—Suppurative inflammation of the choroid is the most severe form of choroiditis, and is the result of injuries to the eye which cause suppurative inflammation of the iris and the whole uveal tract; as it generally involves the entire eye and even its appendages, the term panophthalmitis well describes it.

Symptoms.—The lids are swollen and red, the entire conjunctiva is infiltrated and chemosed and there may be a purulent secretion from the conjunctiva. The cornea is clouded and the iris discolored and adherent, and a yellow reflection appears behind the lens, or the aqueous is so clouded that the deeper portions of the eye cannot be examined. The orbital tissues become infiltrated and the eyeball is pressed forward, and may be immovable. The vision is rapidly lost and even perception of light may be absent. There is generally severe pain which lasts during the whole course of the disease. There is often febrile disturbance and vomiting. Again, the disease may appear with much milder symptoms, general injection of the globe, and the yellow reflex from the pus behind the lens being the first indications of this grave malady.

Causes.—Among the traumatic causes which may be mentioned, are injuries of the iris, wounds or foreign bodies lodged within the eyeball, dislocation of the lens into the vitreous by accident, or from reclination of cataract, or after operations for the extraction of cataract. This disease may also result from pyemia, metastatic abscess, or embolism during the puerperal state, low fevers, mumps, caries of the temporal or cranial bones, or cerebro-spinal meningitis.

Treatment.—If the case is a mild one, atropine and hot compresses together with the use of Phytolacca or Hepar s. may enable us to save the eyeball and perhaps some vision; when the condition has been excited by a swollen, cataractous lens or a foreign body, it should be removed, if possible. If the foreign body is beyond reach, it is better to enucleate the globe unless the inflammatory process is very violent, when it will be well to wait until the more severe symptoms have subsided, as enucleation in panophthalmitis is attended with considerable

difficulty and danger, as it may result fatally. The severe cases will require hot applications and an early incision through the anterior part of the eyeball, which will allow of the escape of the lens and some of the purulent vitreous and thus mitigate the pain. Attention to diet will be necessary, and if the condition of the patient requires it, a full allowance of nourishing food, and perhaps stimulants to sustain the strength, will be indicated. When the disease is well established but little can be done with remedies beyond preventing further complications, as the eyeball is almost certain to be destroyed. The remedies which may be indicated are Phytolacca, Rhus tox., Arsenicum, Hepar s., Merc., Silicia, or Sulphur, in the order given; the concomitant symptoms, more than the special indications, deciding the choice.

Sclerotico-choroiditis Posterior has been considered when speaking of myopia, and its ophthalmoscopic appearances given. When progressive, the process is essentially the same as that of disseminate choroiditis.

Other clinical forms of choroidal disease are observed, but of much less importance; of these, what are termed *colloid excrescences* merit notice. These consist of minute nodules, which appear like mustard seeds, and usually spring from the lamina vitrea, the internal limiting layer of the choroid, and extend toward the retina, displacing and causing absorption of the retinal pigment, but do not interfere with the other layers of the retina, nor do they affect the choroidal stroma or interfere with vision. In rare cases, *miliary tubercles* are observed scattered through the choroid and are a constant accompaniment of acute tuberculosis and present a very similar appearance to colloid excrescences, although the masses are larger, being about one-third or one-half the diameter of the optic disc, and generally occur beneath the pigment layer and present a hemispherical shape, with the summit internal and reflecting the light.

Sarcoma of the Choroid is the only variety of tumor which has its origin in this tissue; when rich in pigment it is called *melano-sarcoma.* It occurs usually late in life, being rarely

seen under thirty-five or forty. Defect of sight is often the only symptom in the early stages of the growth, but sooner or later the tension becomes increased, and pain and all the symptoms of acute or sub-acute glaucoma appear. The tumor appears as a brownish rounded mass with a broad base and, as it grows, pushes the retina before it. Detachment of the retina around the tumor, either from hemorrhage or effusion, accompanies the growth, and in the early stages may render the diagnosis uncertain, but soon it will appear through the retina and will be distinguished by the irregular vessels upon its surface. As long as the tumor is confined to the interior of the eye, the growth may be very slow. The tumor, after filling the eye, will, if not checked by removal, soon appear as a fungous mass between the lids, or involve the tissues of the orbit and the brain.

Treatment.—The early removal of the tumor, while confined to the eyeball, is demanded, for if enucleation is performed before the optic nerve or the orbital tissues become involved, the prognosis is reasonably good, though the danger of secondary growths in the more distant organs, especially the liver, must be remembered.

DETACHMENT OF THE CHOROID from the sclera may result from injury, the growth of tumors, or from collections of blood or serum behind it, and may be mistaken for a sarcomatous growth. In many cases the sudden effusion beneath the choroid results in separation of its tissue or *rupture of the choroid*, which allows of the escape of the fluid into the vitreous.

COLOBOMA OF THE CHOROID is a congenital absence of a portion of its tissue extending from the optic disc to the ciliary body, or it may be quite small and confined to the part around the nerve. The sclera is exposed, and with the ophthalmoscope the coloboma appears as an extensive atrophic spot in the choroid. It is almost always accompanied by a congenital cleft of the iris.

ALBINISM is a congenital absence of the pigment layer of the retina and pigment stroma of the choroid, as well as of

the ciliary body and iris. The pupil appears pink from the light being transmitted through the sclera. Sight is defective and such patients suffer from photophobia and nystagmus.

Slight relief is obtained by the use of dark glasses to moderate the light.

CHAPTER XIX.

GLAUCOMA.

The word glaucoma—derived from the Greek *glaucos*, green —was originally applied to cases of loss of vision accompanied by a greenish color of the pupil due to turbidity of the vitreous.

Since the ophthalmoscope came into use, the term glaucoma, while only expressing an occasional condition which may be presented in the later stages of the diseased condition, is still retained but is now understood as indicating in the eye the presence of a certain group of symptoms, which are characterized by an increased fluid tension of the globe.

The definition which seems to cover and explain the group of symptoms to which the term is now restricted is this:—"Glaucoma is the expression of a disturbance in the equilibrium between secretion and excretion, characterized by an increase in the fluid contents of the eyeball."

Glaucoma, then, consists in an increased tension of the globe, which leads to degenerative changes in the optic nerve, retina, choroid, and indeed of the whole of the interior structures of the eye with loss of function.

Varieties.—Several divisions of the glaucomatous process are made according to the clinical manifestations of the disease; practically, however, two varieties only need be considered, viz: 1, acute or inflammatory; and 2, chronic or non-inflammatory.

ACUTE OR INFLAMMATORY GLAUCOMA.

The term acute or inflammatory glaucoma is applied to that class of cases where there is an inflammation of certain structures of the interior of the eyeball, associated with great congestion, consequent increase in the fluid secretion and accompanied by an interruption in the exit of the fluids from the eye.

CAUSES. — The primary exciting cause is commonly an inflammation of the iris, or cornea, or an irido-choroiditis of a serous nature. It quite frequently follows injuries, as in punctured wounds of the cornea with rupture of the lens capsule, and consequent swelling of the lens substance which presses upon the iris and the latter interferes with the free exit of fluid at the angle of the iris into the canal of Schlemm. Again, the pressure of the lens upon the iris may cause an iritis which blocks up the channels for exit of the fluid and increases the tension. Again the increased tension may occur as a result of ulceration and perforation of the cornea when the iris has prolapsed into the opening. During or after iritic inflammations which have caused occlusion of the pupil or complete adhesion of the iris to the surface of the lens, or after cataract operations which have left a pupil closed by a false membrane. Tumors in, or even upon the eye, often give rise to attacks of glaucoma. When occurring from these causes it is termed *secondary* or *consecutive glaucoma.* Acute inflammatory glaucoma may arise idiopathically, or occur as an acute exacerbation of the chronic form.

SYMPTOMS AND DIAGNOSIS. — Acute glaucoma comes on suddenly and the first symptoms observed are increased tension and ciliary neuralgia. The globe is congested from sub-conjunctival injection, the anterior ciliary veins are prominent and turgid. The iris is sluggish in movement and the pupil dilated. The cornea appears dull, its epithelium perhaps punctated, and there is some loss of sensibility. The aqueous and vitreous are turbid and ophthalmoscopic examination impossible. The diagnosis of increased tension when the lids are swollen becomes difficult and often impossible. The

vision which before may have been good, now becomes markedly decreased. The diagnostic feature is the increased tension which is readily detected upon palpation.

Acute glaucoma may be confounded with iritis, as the scleral congestion, dilated pupil, and shallow anterior chamber and periorbital neuralgia may be present in both. The injection together with the pain which may be referred to the whole side of the head, and the constitutional disturbance may also lead one to mistake the attack for one of cerebral trouble, but the close inspection of the eye and the testing of the vision will remove any doubt. The attack may arise without warning during the night and intense pain in the eye, forehead, or temple, be the first symptom complained of. Injection of the ocular conjunctiva rapidly appears and chemosis and swelling of the lids follow. The iris is discolored and dilated, and the anterior chamber shallow. The aqueous becomes turbid and the cornea hazy and no satisfactory inspection of the fundus can be made with the ophthalmoscope. The vision is rapidly impaired or wholly lost within a few hours. The condition may exist for a few hours and the symptoms rapidly disappear and the vision return. Again the attack may not subside for several days and the sight be entirely destroyed. Cases where the attack comes on suddenly and is accompanied by severe constitutional disturbance, with complete loss of vision from the start, have received the name of *glaucoma fulminans*.

TREATMENT.—When the glaucomatous condition occurs after injury, prompt measures must be used to relieve the fluid pressure, by paracentesis of the cornea, or when a swollen lens is the exciting cause it will be necessary to extract it. In other cases when the iris is not adherent to the lens temporary relief may be obtained by the use of a solution of eserine to contract the pupil. Finally, it will be necessary to make an iridectomy if the tension is not lessened by other means.

CHRONIC GLAUCOMA.

In *glaucoma simplex* or chronic glaucoma we find, as a rule, two stages presented, the so-called premonitory and the confirmed conditions.

The *premonitory stage* of glaucoma which may precede confirmed glaucoma by a period varying from a few weeks or months to several years, is characterized by the early appearance of, or the rapid increase of the existing, presbyopia, which requires repeated changes of glasses for near work. Halos or colored rings appear from time to time around the candle or artificial lights, and the field of vision is more or less contracted at times, or the vision is obscured and foggy, and the patient complains of the appearance of smoke before the eyes. The tension of the eyeball is more or less increased, the retina hyperæmic, and the arteries are seen to pulsate when viewed by the ophthalmoscope, or pulsation is easily produced in them by light pressure of the finger upon the ball. These symptoms, except the presbyopia, which remains increased, are presented from time to time and last from a few moments to several hours, and then pass off and the vision again becomes normal. The periods of remission become shorter and shorter and after a few months or a year, very rarely longer, these prodromal attacks are succeeded by the confirmed condition.

Causes.—The causes of non-inflammatory or chronic glaucoma are as yet not fully known. It may follow upon one or more attacks of acute glaucoma. It is rarely observed under thirty years of age and occurs usually at or about the age of fifty years. Certain races (Jews) and particular families seem prone to the disease owing to a want of elasticity of the sclera, others (Arabs) enjoy immunity from it owing to remarkable suppleness of the membranes and the absence of fatty degenerations at any age. Sex seems to have no bearing upon the etiology of the disease, although women seem to be more liable to it than men. It occurs more frequently in hyperopic than in myopic eyes. Neuralgias of the fifth nerve, degenerative changes and hemorrhages in the retina, and adhesions of the iris and changes in the anterior portions of the eye which tend to keep up an irritable condition of the eye, are liable in elderly people to produce glaucoma. Among other exciting causes, mental anxiety and loss of sleep may be

mentioned. The use of atropine seems sufficient to excite a glaucomatous condition in some eyes.

The theories as to the local cause of the increased tension are various, and seem to satisfactorily explain the condition in individual cases and it is not probable that the glaucomatous condition is due to the same cause in all cases. Whatever the productive cause may be it is aided by the loss of distensibility which the sclera always undergoes with advancing age. The theory of Donders, that there is primarily a neurosis of the fifth nerve which occasions a hypersecretion of the intra-ocular fluids, well explains the glaucomatous symptoms in some cases. In the majority of cases the condition is undoubtedly due to the obstructions of the exits of the fluids from the eye. Recent pathological researches have shown such obstructions to exist from morbid changes near the attachment of the iris, ciliary muscle and canal of Schlemm which would impede the escape of fluid from the anterior chamber. Again the openings in the ligamentum pectinatum at the angle of the iris have been found filled with plastic exudation, or obliterated, and as the major portion of the fluid which has been used to nourish the interior structures of the eye, together with that secreted by the surface of the iris, passes through this porous structure to reach the canal of Schlemm, any interference with the normal removal of the fluid must result in increased tension. The increase of tension which may arise from these causes may be slight at first, but tends to interfere still more with the exit of fluid through the natural outlets and if it persists for any length of time produces changes in the delicate structures of the eye from pressure, or precipitates an acute inflammatory attack. Changes in the oblique channels in the sclera which give passage to the venæ vorticosæ, may also by obstructing the flow of venous blood, occasion an increase of tension in the posterior chamber which may rapidly involve that of the whole eye. The same condition may arise in cases of complete adhesion of the iris to the lens which prevents the passage of the nutritive fluids from the vitreous into the anterior chamber.

RESULTS OF PRESSURE.—The immediate effect of increased tension of the eyeball is to lower the functional activity of the retina by retarding the circulation of the blood through it. When the retinal vessels can be seen in glaucoma the arteries are narrowed and perhaps pulsating while the veins are tortuous and full. The contraction of the visual field occurs from

FIG. 142.

the greater resistance which must be overcome by the circulation to reach the peripheral portions of the retina. If the fluid pressure continues for a time the optic nerve fibres suffer from stretching and atrophy. The lamina cribrosa which forms the floor of the disc, being the weakest part of the ocular envelope, is pressed backward by the pressure of the increased fluid, the soft fibres of the optic nerve are pressed upon in the same manner and ultimately atrophy. The result is that the disc becomes not only atrophied, but depressed or excavated as in Fig. 142. This depression or excavation constitutes the *glaucomatous cup* which, when deep, presents steep or overhanging edges.

SYMPTOMS AND DIAGNOSIS.—The chronic variety of glaucoma is distinguished from the acute form by its slower and more insidious progress. One eye alone may be affected but sooner or later the other becomes involved. As has already been stated it may follow upon one or more acute attacks, or exhibits the symptoms of the premonitory stage, the most important of which is the premature development or rapid increase of the presbyopia. The pain is less violent than in the acute attacks, and the conjunctival injection less marked or absent, but there is a marked turgidity of the anterior ciliary veins. The iris is sluggish in movement and the pupil dilated, often to its full extent. The cornea appears normal or may be dull and often more or less insensible to touch. The sclera often presents an unnatural whiteness which makes the tortuous veins more prominent. The anterior chamber may be normal or shallow, and the iris and lens pressed forward. The characteristic signs, however, are increased intra-ocular tension, excavation

of the optic papilla and the regularity with which the pressure acts upon the retina, first limiting, and eventually destroying the field of vision.

Increased tension, and sluggishness with slight or full dilatation of the pupil are more valuable as diagnostic signs than the excavation of the disc, as the latter may be present as a physiological condition. If, however, we have pressure-excavation the veins appear flattened and dilated at the edge of the excavation (as in Fig. 143 which shows the ophthalmoscopic appearance of the glaucomatous cupping), and arterial pulsation will be produced by slight pressure of the finger upon the eyeball. The final confirmatory symptom, after palpation and the evidences of pressure upon the papilla, is the condition of the sensibility and circulation of the retina. Central vision is only slightly impaired at first, but the field of vision is found contracted, the inner or nasal side suffering first, then the inferior and superior portions in turn, until only a narrow slit, widening outward, is left, and the sight may remain relatively good as long as the narrow end of the slit has not passed beyond the point of fixation. When there is concentric limitation of the field of vision, and the field of colors but little disturbed, the loss of vision is due to pressure-excavation and not to nerve atrophy. With this condition the patient is liable to acute inflammatory attacks which supervene upon such exciting causes as over-use of the eyes, mental emotions, over-indulgence in stimulants, or any cause which may increase the ocular congestion. Any one of these attacks may destroy the vision completely.

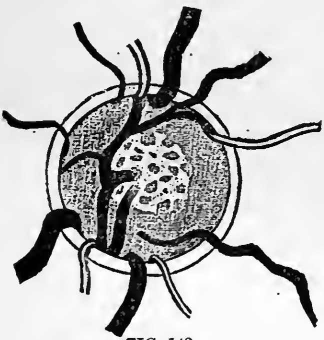


FIG. 143.

When the glaucomatous condition has existed for a long time and there is permanent increased tension with total loss of vision, degenerative changes result and the term *absolute glaucoma* is applied. The anterior chamber is shallow, the iris

widely dilated and atrophied, the lens transparent, or cataractous, and the pupil greenish. If the media are clear the ophthalmoscopic examination shows deep cupping of the nerve, absence of capillaries and lessening and disappearance of the arteries, and turgid veins. There is frequently constant or paroxysmal pains in and about the eye.

Differential Diagnosis.—The chronic form of glaucoma, being insidious in its approach, forms one of the most frequent causes of preventible blindness, as it often goes undetected until the vision is to a great degree lost, and occurring as it does in patients of fifty years or more, it is too readily attributed to failure of vision from old age. The patient, however, finding there is no permanent improvement of vision from the frequent changes of spectacles which he has made, calls the attention of his medical attendant to his failing vision. Here the disease is frequently not recognized and more frequently mistaken for one of cataract, owing to a smoky appearance of the lens in the pupil, and the patient is advised to wait until the cataracts are mature when he can be operated upon with restoration of his vision. Reassured by the advice of his physician he watches his vision disappear from week to week until the sight in one or both eyes is reduced to simple perception of light, and is then sent to the oculist who in turn finds that the opportunity for the practice of Von Graefe's brilliant discovery has passed, and the patient returns to his home hopelessly blind.

Like cataract the disease is usually symmetrical and one eye may be affected a longer or shorter interval before the other. It occurs, as does senile cataract, generally in patients considerably past middle life, unless arising from injury or secondary to inflammatory changes in the structures of the eye, when we may have it appearing as does cataract at any age.

Like cataract there may be the gradual failure of sight, this loss of vision being frequently attributed to senile changes. The reduction of central vision, however, is not as frequent as the impairment of the field of vision particularly on the nasal side. There are, not unfrequently, periods of blindness last-

ing from a few minutes to a few hours, in cases of chronic glaucoma; these attacks may occur with little or no pain, the pain when present being referred to the eyebrow or forehead.

With cataract the halo about the source of illumination may appear, rarely the colored fogs or rainbow tints as in some cases of glaucoma.

With glaucoma we have a rapid increase of the existing presbyopia, that is the patient is no longer able to read at his usual distance with his glasses, but must hold his paper further from him, and changes his glasses for still stronger ones to keep pace with the increasing weakness of the ciliary muscle, until, finally, he finds even with the strongest glasses his vision is not improved. The cataract patient also, as he finds his vision failing, changes his glasses but gets no improvement, as the fault lies not in the paresis of the accommodation but in the loss of transparency of the crystalline lens. On examination of the eye, we find in the glaucomatous case, a dilatation and sluggish condition of the pupil, whereas in cataract we have the pupil normal or contracted as in the aged.

Again the cataract patient will tell you that his sight is better in the evening or by shading the eyes with the hand, while the vision in glaucoma is not improved in this way.

We also notice that in glaucoma with the dilatation of the pupil, we have a shallow anterior chamber, the cornea flattened and frequently showing loss of sensibility. With cataract we have the anterior chamber, the curvature and sensation of the cornea normal.

With glaucoma we may have a steamy or ground glass appearance of the cornea, which in cataract is transparent. With oblique illumination we discover at once the opacity of the lens in cataract, and in glaucoma we frequently find an apparent haziness of the lens, which is not necessarily the result of the disease, or if the intra-ocular tension has existed for some time, we may find cataract resulting from the glaucomatous condition. The ophthalmoscope shows in glaucoma hyperæmia and cupping of the optic disc, and spontaneous or easily producible pulsation of the retinal arteries. In cataract

we are unable to obtain a view of the fundus as the view is arrested by the loss of transparency in the lens and not from turbidity of the vitreous.

Finally, as has already been stated, with cataract we have no attendant pain, with glaucoma we may have pain or inflammation. With cataract the tension of the eyeball obtained by the sense of touch, gives no sensible resistance; in glaucoma, however, the sense of hardness becomes apparent at once if the tension is great, and in case of doubt, it should be compared with that of the normal eye.

Treatment.—In the prodromal stage the operation of iridectomy is not indicated, unless the patient is likely to be lost sight of, or when decided hardness of the globe remains after the attack has passed off. Every precaution should be taken to prevent cerebral and ocular congestion. Light smoke-colored protective glasses should be used. All excesses of either eating or drinking should be strictly enjoined. Sleep immediately after a full meal should be forbidden and the use of strong tea or coffee stopped. The eyes should not be exposed to bright lights, cold winds or dust. Any causes of ill-health should be carefully investigated and removed if possible, and the endeavor made to put the patient in a good condition. If the vision becomes impaired or the glaucomatous condition becomes confirmed, or inflammatory symptoms supervene an iridectomy should be made at once.

For the chronic or confirmed glaucoma the only known remedy which seems at all beneficial is iridectomy. The discovery of Von Graefe, that the removal of a large section of the iris was capable of lessening the intra-ocular tension and curing in many cases the glaucomatous condition, will ever cause his name to be held in the highest honor, for the means thus afforded of saving a great many eyes from absolute blindness. The operation of iridectomy, however, is not the only remedy we have for the condition, but it properly heads the list, and if prompt relief is not obtained from other measures no hesitancy should cause any delay in the performance of the operation.

Of homœopathic remedies, Bell., Bry., Colocynth, Gels., Prunus, and Phosph., have been of undoubted benefit in the premonitory stage, and have a marked action in relieving the pains and periodical exacerbations.

The local use of eserine solution diminishes the tension of some cases of glaucoma and in a few cases has proved useful.

The severe pain which is present during exacerbations of the glaucoma may be somewhat mitigated by the use of hot moist applications to the eye and if the pain is intense it will be necessary to prescribe an opiate.

Iridectomy cures glaucoma by the permanent reduction of the tension which follows the operation; the rationale of its action, however, is not yet understood, yet no doubt can be entertained of its curative properties and the delay, sometimes of only a few hours, to perform the operation when there is increased tension may produce irreparable blindness. In order that iridectomy may produce a lessening of the tension of the eyeball a large segment, at least a quarter or even a third of the iris must be removed, and it must be taken away quite up to its ciliary attachment, a result which is better attained by two or three sections with the scissors, than with only one clip as in an ordinary iridectomy. The incision should be made in the cornea close to the sclero-corneal junction and in a direction parallel to the plane of the iris. The modus operandi of the operation has already been given on page 287. The following rules are to be considered in deciding upon the necessity for the performance of an iridectomy in glaucoma.

No iridectomy is to be performed in the premonitory stage of glaucoma as long as the field of vision is not contracted. When acute inflammatory symptoms appear in an eye which has exhibited increased tension an operation should be made without delay.

When the chronic condition exhibits more or less inflammatory tendency the performance of an iridectomy affords the patient the only chance of saving his vision. There is a form of glaucoma which is marked by stony hardness of the eyeball after a few hours with complete loss of vision and yet

without inflammation, the *glaucoma maligna* of Von Graefe, in which iridectomy is constantly followed by intra-ocular hemorrhage. Here it is not wise to make an iridectomy. Again the operation of iridectomy is contra-indicated in those cases of increased eyeball-tension which exhibit hemorrhages in the retina or choroid, the *glaucoma hemorrhagica*. The operation of iridectomy also seems to precipitate an attack of acute glaucoma in the other eye, but the cases which are likely to be followed by such disastrous results are not determinable before operating. Among the other measures which have been proposed and used for the relief of glaucoma are sclerotomy and myotomy, trephining the sclera, and the insertion of a gold wire suture through the sclera. Of these the only one which has proved of value as a substitute for iridectomy is the *operation of sclerotomy* which is performed in the following manner. The pupil is to be well contracted by the instillation of eserine and a linear cataract knife introduced on the temporal side one millimetre behind the sclero-corneal junction, and three millimetres above the horizontal meridian. The point of the knife is carried slightly forwards, in front of the iris, pushed across and brought out at a point exactly opposite to its entrance. The incision is made slowly upward, close in front of and parallel to the plane of the iris, until the edge of the knife reaches the upper portion when it is directed slightly forward and the aqueous allowed to drain off, a bridge of uncut sclera is left and the knife slowly withdrawn, a solution of eserine introduced and a bandage applied. The relative positions of the incisions for iridectomy (I) and sclerotomy (S) are shown in Fig. 144.

FIG. 144.

After either of these operations the wound sometimes closes imperfectly, and a *cystoid cicatrix* is formed. In these cases the wound generally closes after the operation, but after a time the ocular tension increases and the scar tissue being more distensible than other portions of the sclera, bulges out. Often the cicatricial tissue is so loose that the aqueous filters

through it and collects beneath the conjunctiva in the shape of a large vesicle, which may cause much irritation or even inflammation, which may destroy the eye. The collection should be removed by pricking it with the point of a needle, and a compress bandage then applied to encourage healing.

The curative value of either iridectomy or sclerotomy is greatest in acute cases; when the operation is performed immediately a complete cure generally results. In sub-acute cases with limitation of the field of vision, the improvement is very slow. In the chronic conditions slight improvement or the preservation of the remaining sight is deemed a good result. If the tension returns after an operation has been made it will be necessary to repeat it, and the iridectomy made opposite the first.

If the vision is entirely destroyed by the prolonged pressure, no benefit will be derived from an operation, beyond the relief of the pain which may present. In very painful cases, when the condition is one of absolute glaucoma, enucleation may be demanded for the relief of the pain.

If, as sometimes happens, the performance of an iridectomy upon one eye hastens the outbreak of the glaucomatous condition in the other, the second eye should be operated upon without delay.

CHAPTER XX.

DISEASES OF THE RETINA.

ANATOMY.

The retina is a delicate membrane which contains the terminal filaments of the optic nerve. Externally it lies upon the choroid, while internally the hyaloid membrane separates it from the vitreous. It extends from the optic disc forward to the ciliary processes where it ends in an indented border, the ora serrata. From this portion there is continued forward on the ciliary processes a fine layer of transparent nucleated cells of columnar epithelium, which constitutes the ciliary portion of the retina, or the *pars ciliaris retinæ*, which disappears as the ciliary body passes into the iris. In the extent of the retina forward its thickness diminishes from $\frac{1}{50}$ to $\frac{1}{200}$ of an inch. In the axis of the eyeball is what is termed the yellow spot, or *macula lutea*, somewhat elliptical in shape and about $\frac{1}{20}$ of an inch in diameter; in the centre of this is a slight depression, the *fovea centralis*. To the inner side of the macula is the white or pinkish disc which marks the entrance of the optic nerve into the interior of the eye. Around the optic disc the retina is slightly elevated, and from the centre of the disc come the retinal vessels which branch above and below and radiate in all directions to supply the inner layers of the retina. Near the macula lutea vessels sweep off above and below (see Fig. 6, p. 11), and leave this region free of the larger vessels. The arrangement of the

capillary vessels in the macula, and their absence from the fovea, is well shown in Fig. 145. In the normal state the retina is transparent and of a pinkish color, but after death it soon becomes opaque.

In the detailed examination of the retina (Fig. 146), ten layers are found, which, beginning with the inner surface of the retina, are described as follows: 1, membrana limitans interna, a thin structureless membrane which separates the retina from the hyaloid; 2, a layer of optic nerve fibres; 3, a layer of ganglionic cells; 4, an internal granular or molecular layer; 5, an internal layer of granules or nucleus-like bodies, of three or four kinds; 6, an external granular layer; 7, external granules; 8, membrana limitans externa; 9, a layer of rods and cones; 10, pigment layer. In addition to these stratified layers certain fibrous structures are seen, which pass through the retina and connect the different layers and really form the tissue skeleton of the retina. These have been termed the supporting fibres of Mueller. Of the ten layers named, some are characterized as belonging to the nerve terminations, as the 2nd, optic nerve fibres; 3rd, ganglionic cells; 5th, inner granules; 7th, outer granules; 9th, the rods and cones. The remaining layers, except the pigment cells, are supposed to form the supporting structure of the retina and consist mainly of connective tissue. The layer of rods and cones, which constitutes the terminal elements of the optic nerve fibres, are

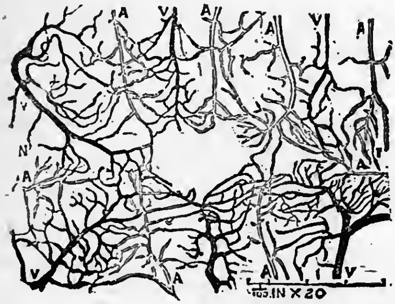


FIG. 145.

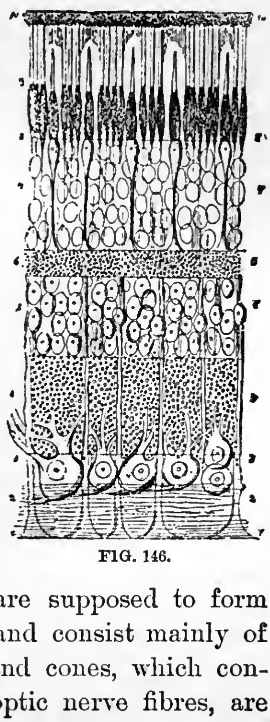


FIG. 146.

of special interest. The rods have an elongated cylindrical form, while the cones are much shorter and thicker and are terminated by a thinner and more tapering process. The rods and cones are closely set together, but are not equally distributed over the expanse of the retina; at the more peripheral portions of the retina, the rods far outnumber the cones, while at the macula lutea only cones are found. The pigment layer consists of flat, hexagonal, epithelial cells (Fig. 147), which are filled with brownish pigment, and on the surface towards the choroid are smooth, while from the inner surface prolongations of pigment extend between the processes of the rods and cones. It is this layer which is supposed to be the active agent in the secretion of the visual purple. At the macula lutea, the most sensitive portion of the retina, where direct vision occurs, the relation of the layers of the retina is somewhat different. All the layers except the 2nd (optic nerve fibres), which is absent, are thickened and only cones are found, while at the fovea all the layers are very much thinned, so that only the 7th layer, with the cones of the 9th, can be demonstrated, the cones here being crowded together and their bodies somewhat thinned.

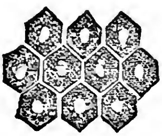


FIG. 147.

The blood supply and lymph spaces of the retina have been considered in the chapter on the general anatomy of the eye. The retinal blood-vessels are found only in the inner layers, the more external layers undoubtedly deriving their supply of nourishment from the choroid. The ophthalmoscopic appearances of the healthy retina (Plate V, Fig. 1) are negative, inasmuch as, the retina being transparent, nothing of its tissue is seen except the blood-vessels, but we must be familiar with their normal appearance if we would be able to diagnose the pathological changes which may occur in the retina. The arteries are of a light red color, smaller in calibre and straighter than the veins, which are dark red, larger and more tortuous. The optic disc is easily distinguished by its white appearance from the surrounding retina, and occasionally fine, grayish lines may be seen radiating from the disc, which mark

the distribution of the nerve fibres. In rare cases these lines are very marked, and white, striated masses may be seen extending some distance out from one side of the disc or partially encircling it and giving to it an irregular outline. This is a congenital condition, and the appearance is due to a greater or less number of the nerve fibres passing through the lamina cribrosa and still retaining their medullary sheaths and appearing in the retina as *opaque optic nerve fibres.* The macula lutea is difficult to distinguish from other portions of the retina, except in children, unless the pupil is well dilated; it appears as a slightly defined grayish circular reflection with a central whitish dot indicating the position of the fovea.

DISEASES OF THE RETINA.

HYPERÆMIA OF THE RETINA.—Hyperæmia of the Retina is very difficult of recognition as the congestion of the vessels must be very marked to enable us to diagnose the condition. The vessels appear darker and more tortuous and the optic disc is more wavy in appearance and there may be slight clouding of the retina around the disc.

Causes.—It may be a transient condition depending upon over-use of the eyes, particularly in hyperopes and myopes, or result from the irritation of foreign bodies lodged in the cornea, or mental emotions, prolonged weeping, inflammatory affections of other portions of the eye, or accompany some derangement of the general circulation or of the digestive organs.

Symptoms.—The complaints are, usually, flashes of light, phosphenes, or other indications of irritation of the retinal elements.

Treatment consists in the relief of all exciting causes, giving rest to the eyes, and using such remedies as Bell., Phos., Dubois., Conium, Bry., Puls., or Verat. vir.

ANÆMIA OR ISCHÆMIA OF THE RETINA results from obstruction of the circulation in the retinal vessels, as will be considered under embolism and thrombus of the central artery.

It also occurs in cases of general anæmia, and has been observed in the prostration following cholera or other diseases. The failure in the retinal circulation occurs suddenly and there is immediate loss of vision, which is usually temporary, the sight returning after a few hours or days.

Treatment.—If the vision does not return after forty-eight hours under the administration of China, Ferrum, Phos., or other remedies that may be indicated, together with the use of nourishing food and stimulants, a paracentesis of the cornea should be made to relieve the intra-ocular tension and restore the circulation.

Embolism or Thrombosis of the Central Artery of the retina, or one of its principal branches, gives rise to sudden loss of vision, which may be complete or partial, depending upon the position and size of the embolus. The vision may be slightly improved by the establishment of collateral circulation, but it is not usually permanent, and the retinal function is lost, or inflammatory changes occur, characterized by œdema of the retina, about the disc or yellow spot, which gives to the choroid a misty appearance, while in the fovea a red spot may appear which simulates a hemorrhage at this point. Later, the redness becomes paler and the retinal vessels affected, when detected, may appear as a whitish cord or not changed, except from the absence of producible pulsation. In a few weeks the disc appears white and passes into a state of atrophy. These cases, which occur very rarely, may arise in connection with diseases of the heart, and according to some authorities are, in the majority of cases, due to *hemorrhages in the optic nerve sheath* which present the same ophthalmoscopic appearances.

Treatment is unavailing, as the sight is completely lost, yet such remedies as Crotalus, Lachesis or Prunus, which may cause absorption of the blood, may be tried when the diagnosis is doubtful.

Hemorrhages into the Retina.—Blood effusions into the retina occur spontaneously in persons of a hemorrhagic diathesis or those suffering from menstrual derangements; also

from degeneration of the blood-vessels, cardiac disease, and from injuries and diseased conditions of the eye, as glaucoma, choroidal diseases in myopic eyes, or inflammation of the retina itself.

Symptoms and Diagnosis.—The vision is affected according to the location and extent of the effused blood and as it approaches or covers the macula lutea. Hemorrhages into the retina are readily recognized by means of the opthalmoscope as red patches, and their appearance depends upon the location and depth of the effusion. If they occur in the vicinity of the optic disc, they are generally more superficial and present a somewhat striated and irregular form as they spread through the nerve fibre layer and cover the retinal vessels. If the patches are deeper in the retinal tissue, they are smaller, the edges more rounded and the retinal vessels may be seen to pass uninterruptedly over them.

Prognosis.—The effusion gradually becomes absorbed, and if very small, may leave no trace; more often pigment spots or deposits of white fibrin result, indicating inflammatory changes at the point. If the hemorrhage is extensive, retinitis is very sure to occur and serious secondary changes follow. If the hemorrhage has occurred in the macula, the sight is rarely regained, and even with the partial restoration of the vision, the layer of cones has generally sustained such displacement as to cause distortion and irregularities in the appearance of objects.

Hemorrhages into the vitreous are often an indication of the diseases mentioned among the productive causes, and may also be the forerunner of cerebral diseases which may involve the life of the patient.

Treatment.—The eye must be given absolute rest and protected from the light, and such remedies administered as may hasten absorption, together with others adapted for the condition which may be the exciting cause. Of the remedies which may hasten the absorption of the effusion, Bell., Lachesis and Crotalus are to be used.

RETINITIS.

Acute retinitis, uncomplicated with inflammation of the choroid, optic nerve or other portions of the eye, is very rare. The inflammatory process takes, usually, a more passive character and the morbid changes occur more slowly. Of the many morbid changes which may occur in the retina, but few of them, however, take origin in, or are confined to, the retina itself. Inflammation of the retina causes certain changes in its structure which lessen its transparency by infiltration of its tissue, resulting in hypertrophy of its connective tissue structure which may cause considerable increase in its thickness and render it opaque. The exudative material may be serous, plastic or purulent. These exudations may be absorbed or pass into a state of sclerosis or fatty degeneration, and the integrity of the retina will suffer according to the extent and length of time the exudation remains.

Causes.—Retinitis more commonly follows inflammation of the choroid, yet we meet with uncomplicated retinitis which is the result of syphilis or some other constitutional dyscrasia, and in patients who have diseases of the kidney, diabetes, menstrual disorders, leucocythemia, malaria, etc. When associated with optic neuritis, brain diseases and other causes excite it.

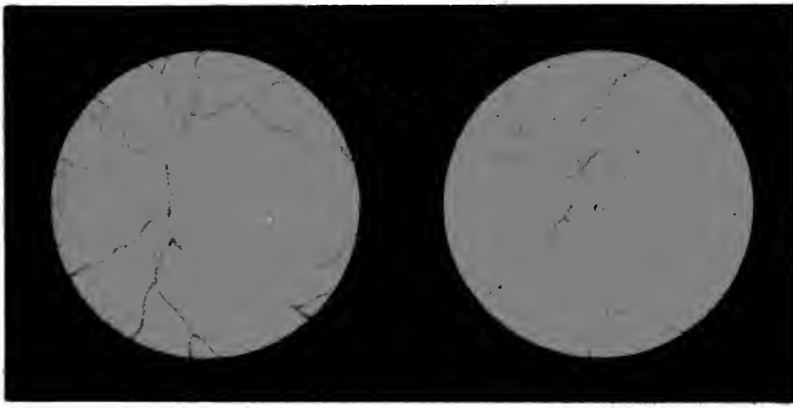
Symptoms.—There are no external appearances of disease in the eye, nor is there any pain, and the impairment of the vision is the only symptom complained of.

The ophthalmoscopic evidences (Plate V, Fig. 4) consist of loss of transparency and the presence of opaque portions of the retina. The opacities vary in size and shape in the different varieties of retinitis; and with the white patches are seen more or less hemorrhagic spots. The varieties of retinitis have been designated, according to their ophthalmoscopic appearances and constitutional causes, into retinitis apoplectica, retinitis albuminurica, retinitis syphilitica, retinitis pigmentosa, retinitis proliferans and retinitis leucæmica.

Retinitis Apoplectica, or hemorrhagic retinitis, is charac-

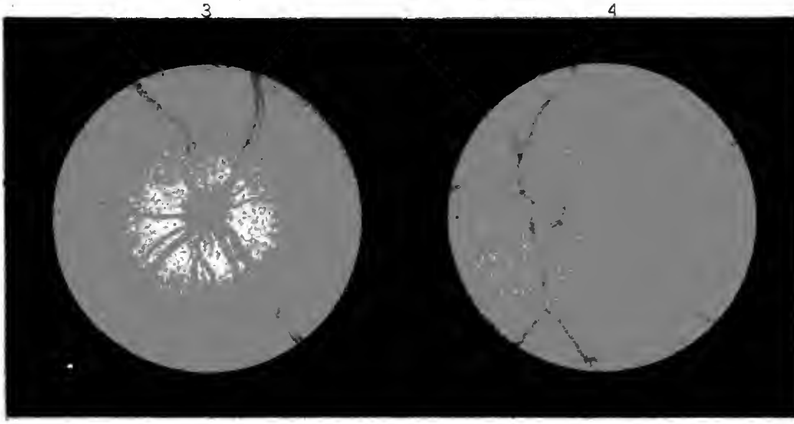
PLATE V

1 2



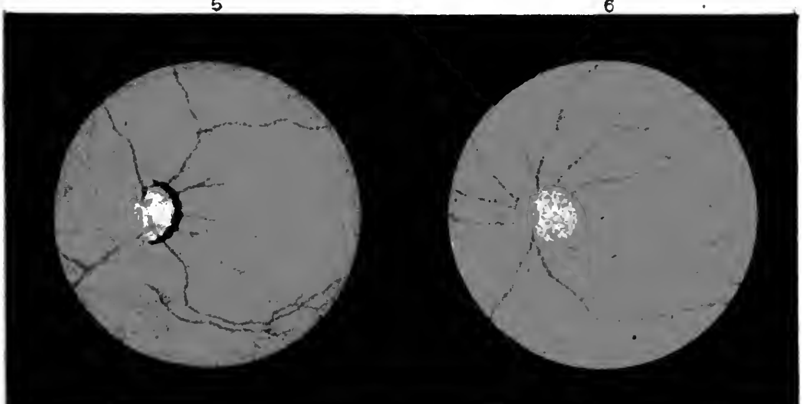
Normal Fundus — Retinitis

3 4

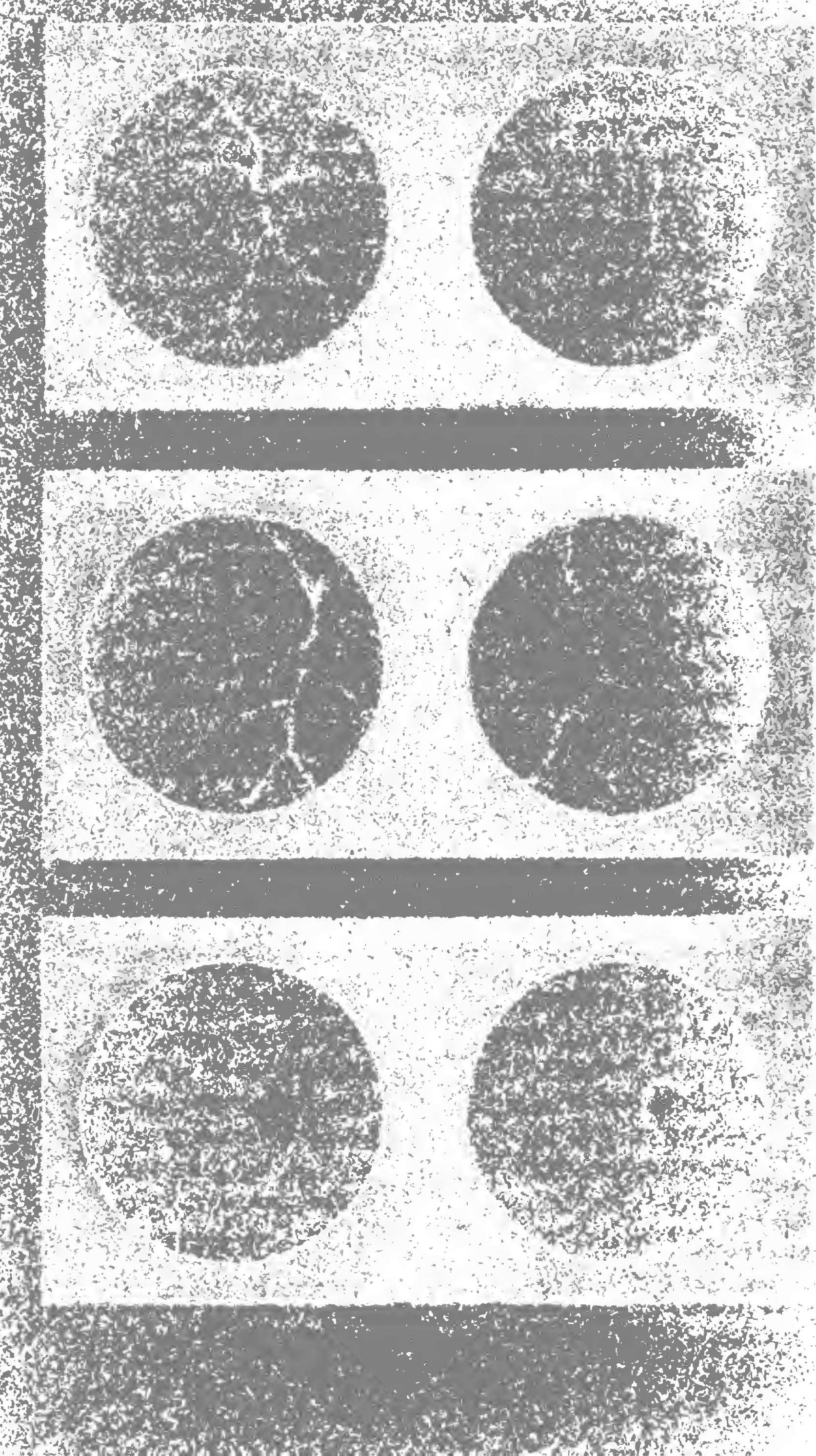


Optic Neuritis — Retinitis Albuminurica

5 6



Atrophy of Optic Nerve After Optic Neuritis — Progressive Optic Nerve Atrophy.



terized by the effusion of blood into the retina in spots of varying size, usually small, which are disseminated over a large portion of the retina and confined to one eye or affecting both. In addition to the effused blood, there is always evidence of inflammation of the retina and optic nerve. The optic disc is hyperæmic, the retinal vessels are enlarged and tortuous, and there is a serous effusion, or small patches of exudation here and there are observed in the retina.

Causes. — Atheromatous conditions of the blood-vessels, diseases of the heart, as hypertrophy and changes in the aortic valves, together with a syphilitic, rheumatic or gouty diathesis seem to furnish the causes of this form of retinal disease. The retinitis which occurs in diabetes frequently assumes the hemorrhagic form.

Symptoms.—The chief subjective symptom is more or less sudden loss of vision; the objective symptoms consist in the exhibition of spots of effused blood in the retina, which are found along the vessels, and the hazy condition of some portions of the retina from infiltration, or the appearance of exudation.

Prognosis. — The prognosis depends somewhat upon the cause, but more upon the extent and location of the hemorrhage. If the hemorrhages are marked in the macula lutea or appear in the fovea, central vision is almost invariably destroyed, while if they affect the more peripheral portions of the retina and the macula is unaffected, and the hemorrhages are promptly absorbed, the result may not be very serious to vision. As a rule, however, the blood is absorbed very slowly and months pass without the effusion clearing up. If the vision is seriously affected the prognosis is usually unfavorable, as entire restoration is very rare, but if the macula has been implicated there is no probability of the return of central vision. It should be remembered that similar effusions are liable to occur in the brain from the same causes, and life be endangered.

Treatment.—Rest from all mental labor and cerebral excitement should be secured, and due consideration given to the

exciting causes. In severe cases, when the hemorrhages are increasing, the eye should be bandaged and the patient confined to bed. In milder cases the patient may have the eyes protected by dark glasses and be allowed moderate exercise. Bell., Phos., Lachesis, Crotalus and Merc. cor., hasten absorption and improve the condition of the retina.

Retinitis Albuminurica, or nephritic retinitis, is a form of retinal inflammation which is characterized by an exudation of albuminous material into the tissue of the retina, which soon passes into fatty or fibrinous degeneration, affecting both the nerve fibres and the connective tissue of the retina. Both eyes are almost always diseased.

Causes.—Albuminuric retinitis is perhaps the most common form of inflammation which is confined to the retina, and is due to some lesion of the kidneys. It is frequently the first intimation of Bright's disease, and may precede all evidence of albumen in the urine for some weeks, or may appear only in the later stages of the disease. It occurs in about eight or nine per cent. of all cases of Bright's disease and usually in the chronic form, and here is more commonly associated with contracted kidney. The albuminuria of pregnancy or scarlet fever may also cause the disease. Any form of kidney disease, as waxy or fibrous degeneration or white hypertrophy, which produces an uræmic condition of the blood, is sufficient to excite the retinal inflammation.

Symptoms and *Diagnosis.*—The failure of the vision is the first symptom which may indicate the eye affection. The ophthalmoscopic picture is a very striking one (Plate V, Fig. 4). The optic disc is more or less hyperæmic and swollen, with indistinct edges, and the vessels turgid, or again the disc may appear flat, white, and the vessels but little changed. In the retina, however, at some distance from the disc, and frequently in the region of the macula, are observed the chief features of the ophthalmoscopic appearances; these consist of opaque white spots of varying size, often very large and striated, which are due to fatty degeneration of the connective tissue of the retina or sclerosis of the layer of the optic nerve

fibres. Hemorrhages are common and vary in size. The retinal vessels are covered by the white patches, or hemorrhages, in a portion of their course and often the exudations are observed along the sides of the vessels. The white patches may consist of white dots which are grouped around the region of the macula, showing white lines which radiate from the fovea with dots between, and the retinal changes appear confined to the region of the yellow spot. In most cases the patches are much larger and coalesce, forming a more or less distinct zone around the disc, with another zone, between the disc and exudation, of apparently healthy retina.

In rare cases we may find what would seem to be the primary stage of the disease, which consists of a delicate haziness of the retina as if from serous infiltration. As the cases do not usually present themselves until the disease is more advanced, there is no opportunity offered for a frequent examination of the eye in the early stages.

Prognosis.—Cases occurring during the course of acute disease of the kidney usually clear up and leave little impairment of the vision unless the macula has been affected, when there is a prompt recovery from the kidney lesion. The course of retinitis in the chronic diseases of the kidney, varies with the condition of the latter. The prognosis is very grave as the vision is very greatly impaired, although total blindness does not usually occur, but as the eye affection keeps pace with that of the kidney, there is little to be expected from the treatment.

Treatment.—The treatment of retinitis is essentially that of the disease upon which it is dependent. Protection glasses and complete rest for the eyes, with such bodily exercise as may be proper for the general condition, are necessary. Internally, those remedies which are applicable to the cause of the disease will be indicated. Among the remedies particularly suitable to the condition of the eye in Bright's disease, Merc. cor., and Gels. are the only ones which have seemed at all beneficial. In retinitis arising during the course of pregnancy, Gelsemium and Apis have been useful. In a case of

retinitis associated with post-scarlatinal dropsy, a cure was effected by the use of Apis.

Retinitis Syphilitica differs from the two forms of retinitis just described, in that the retinal changes are due to infiltration with serum and fibrine, and of lymph corpuscles, with resulting hypertrophy of the connective tissue. Hemorrhages and large patches of sclerosis or fatty degeneration are commonly absent, and there is a greater tendency to choroidal implication than with the other varieties.

Causes.—The disease appears usually among the later secondary symptoms of syphilis, and also among the tertiary symptoms of inherited syphilis. In women it may appear among the first symptoms of acquired syphilis, the primary sore and the light secondary symptoms having been unobserved.

Symptoms and Diagnosis.—The sight is often greatly impaired when but slight changes are observable in the retina, and, on the other hand, the vision may be but slightly disturbed when the retinal lesion is very great.

The retina, particularly at the centre of the fundus, or along the vessels, appears hazy, and yellow spots of exudation are discernible; these are often very minute and granular and more frequently appear about the macula lutea, where the disease shows a tendency to locate. Patients not infrequently complain of phosphenes, flashes of light, scotoma, and changes in the appearance and size of objects, from the disturbances of the relation of the cones at the yellow spot. One eye or both may be affected and the vitreous may become hazy.

Prognosis.—The disease may last from three to eight weeks or as many months and shows a great tendency to recurrence. Many cases recover without serious impairment of sight, if there is no implication of the choroid and the general condition is fair. When the macula is the seat of the lesion, the prognosis becomes grave, as the vision is always impaired and in many cases destroyed. Atrophy of both the retina and optic nerve may follow the retinitis, or the latter may be the forerunner of brain disease.

Treatment.—The treatment is to be directed to the constitu-

tional causes, and of the remedies which are likely to be further indicated for the general condition by the eye lesions, Kali iod., Merc. cor. and Aurum may be mentioned.

RETINITIS PIGMENTOSA is a chronic form of progressive inflammation which manifests itself by proliferation of the connective tissue of the retina and its pigment epithelium with consequent atrophy of the nerve elements. The condition appears to be one of atrophy of the whole tissue of the retina with proliferation of the pigment. Its pathology is still in doubt, but it is probably more a degenerative condition which may be preceded by slight inflammatory symptoms.

Causes.—The causes are unknown, but the malady is usually hereditary, at least more than one member of a family are commonly affected.

Symptoms.—The disease is usually discovered in consequence of the patient's complaining that vision is defective except in very bright light, and that late in the day, or during twilight, or after dark, vision is very poor or impossible. This condition of the vision, *hemeralopia*, or night blindness, arises because the retina requires the full stimulus of daylight to enable it to act. In addition to this, the field of vision is contracted, and as the disease advances lessens, until at last central vision disappears and complete blindness follows. The ophthalmoscopic appearances in the early stages of the disease are very characteristic; toward the equator of the fundus numerous irregular mossy-like patches of pigment with star-shaped projections are seen, particularly along the line of the blood-vessels. The vessels are lessened in calibre and straighter; as the disease advances these pigmentary changes become more numerous and approach the disc, which becomes whiter, the blood-vessels are attenuated, the retina hazy, and, as the disease involves the macula, the vision disappears entirely.

Prognosis is unfavorable, as, in the present state of our knowledge of therapeutics, the disease results in complete blindness. The time necessary for the completion of the atrophic process is often many years, as it advances slowly.

Treatment.—As yet nothing has been found which seems to have any effect upon the disease beyond those measures which are instituted to improve the general condition of the patient, and such care of the eyes as may retain the sight as long as possible. Temporary benefit sometimes results from the use of Lycop. and Phosph.

RETINITIS PROLIFERANS is a rare form of retinal inflammation, which is characterized by the development of connective tissue in the vitreous.

RETINITIS LEUCÆMICA is also a very rare variety of retinitis which occurs in some cases of leucocythæmia. The fundus of the eye presents a yellow aspect, with white patches of lymph corpuscles and hemorrhagic spots scattered over the retina.

DETACHMENT OF THE RETINA.—Separation of the retina by effusion of blood or serum between it and the choroid, may take place in different portions of the fundus and may be partial or complete. If the effusion takes place in the upper portion, the fluid gravitates to the bottom, as in Fig. 148, detaching the retina as it works down, while the upper portion may again become adherent. Hence the displacement of the retina is more frequently observed in the lower part of the fundus.

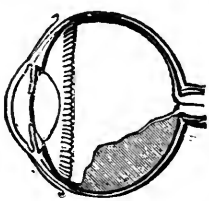


FIG. 148.

Causes.—The most frequent cause of retinal detachment is myopia, particularly of a high degree and when associated with choroidal diseases and fluidity of the vitreous. It occurs, however, in emmetropic eyes as the result of severe injuries to the eye, of iritis, choroiditis, and neuro-retinitis with vitreous changes, or in derangements of the nerves with lessened pressure in the vitreous, as indicated in diminished eyeball tension after injuries that have induced inflammation, with subsequent fluidity of the vitreous. The detachment may be complete, the retina having a funnel shape with the apex at the optic disc.

Symptoms.—Detachment of the retina causes a defect in the field of vision corresponding to the location of the separation;

if the detachment occurs in the lower portion of the retina, the patient is unable to see anything above a certain line. The disturbance of vision varies with the amount and location of the detachment; if the retina is detached at or near the macula, the impairment is much greater, than if a more extensive separation exists at its periphery. The patient may first notice that the vision is clouded, and objects appear wavy or distorted, and fringed with prismatic colors. Again, colored or white bodies appear before the eye or flashes of light arise from the irritation of the retinal elements. With the ophthalmoscope detachment is easily diagnosed, as the separated retina presents a bluish-gray, floating, tremulous, wave-like opacity which is thrown into folds, or has an undulating appearance on any motion of the eye, as in Fig. 149. If the retinal vessels are traced from the disc to the detached portions, they will be seen to end abruptly or bend backward, or as they pass over the projecting retina they are nearer to our eye and require a change of focus from that necessary to observe the vessels on the other portions of the retina. When the detachment is complete the vision is completely destroyed, and the retina appears as an opaque bluish mass behind the lens, if the latter is not already cataractous.

FIG. 149.

Prognosis.—In rare cases absorption of the fluid with re-attachment of the membrane and restoration of the vision takes place. As a rule these cases of detachment present an unfavorable prognosis. Some cases may remain stationary, but more frequently the effusion increases until the separation becomes extensive or complete and the vision destroyed.

Treatment.—The operation of puncturing the retina by the introduction of a cataract needle through the sclerotic has, in the hands of some operators, proved beneficial, but the operation has not been sufficiently successful to make the procedure of any value. The best method of treatment, if the detachment is recent, is to confine the patient to bed, bandage the eyes, and administer such remedies as may induce absorption.

If the detachment is old, the eyes should be protected from the irritation of light by dark glasses and all use of the eyes avoided. Occasionally the local use of atropine is advantageous, the rest for the ciliary body which results from its use preventing further detachment. The most brilliant results have followed the administration of our homœopathic remedies in some of these cases, particularly Gelsemium, Arnica and Aurum. Benefit has also been derived from Apis, Merc. and Digitalis. Other remedies will undoubtedly be found valuable in the treatment of detachment as opportunities for the clinical application of our remedies to the condition increase.

FUNCTIONAL DISEASES OF THE RETINA.

Hyperæsthesia Retinæ or extreme sensitiveness of the retina may be a symptom of inflammation of that tissue, but is also the result of close application of the eyes in fine work on bright or glistening objects, as in two cases which have come under my notice where the condition resulted from prolonged efforts with the microscope in the one case, and the other occurred in a metal turner who worked on brass disks in a bright light. In these cases there were no changes in the retina beyond a possible hyperæmic condition. It is more frequently met with in hysterical or hypochondriacal people who generally present some refractive trouble, associated with accommodative or muscular asthenopia, and usually follows an attack of illness. Two cases I have seen follow the puerperal condition.

Symptoms.—There is great sensitiveness to light, and often complete inability to use the eyes. Exposure to light, or attempted use, brings on lachrymation, pain and blepharospasm. Milder cases may complain only of dazzling, or the retinal impressions may persist for a longer time than usual and interfere with the rapid inspection of objects, or remain after the eyes are closed. These patients in severe cases confine themselves to close rooms from which every ray of light is excluded or even then keep the eyes bandaged.

Prognosis.—The prognosis is favorable, as the proper treatment is prompt in relieving the condition, and the dread of blindness, which is the reactive cause, may be relieved by encouraging assurances, after a complete examination has been made.

Treatment.—An examination of the eyes should be made even if it is necessary to administer an anæsthetic, when any refractive errors must be determined by the ophthalmoscope, and in the absence of any retinal changes which may be productive of the condition, the patient should be assured of a full recovery. This encouragement itself is productive of the greatest good, as these cases commonly appear in nervo-hysterical subjects.

Locally atropine may be useful, and the patients should be admonished not to exclude the light but gradually accustom the eyes to it, and this will aid materially in relieving the fears of the patient. Any error of refraction should be corrected as soon as possible, and the general condition of the patient improved by proper hygienic measures. The proper homœopathic remedy is invaluable in the treatment of these cases and the results of its administration are wonderful at times. Of these remedies Bell., Conium, Ignatia, Macrotin, Nux Vomica and Natrum mur. are particularly serviceable, while Acnoite, China, Hyos., Lactic acid and Merc. sol. may be indicated more rarely.

Snow Blindness is an affection resulting from prolonged exposure to the bright reflection of the light from areas of snow and during winters which are accompanied by great snow falls which remain for weeks or months. These cases are frequently met with in our northwestern states. There is often extreme irritability of the eyes with conjunctival hyperæmia, pain and extreme photophobia. The immediate symptoms may pass off in a few hours or days, but in the cases which usually come to the city for treatment there is a marked hyperæsthesia of the retina, which may persist for weeks or months afterwards. The treatment is the same as that already given for hyperæsthesia of the retina.

Nyctalopia or day blindness is sometimes applied to certain cases of hyperæsthesia retinæ where the patients are able to use the eyes in dimly-lighted rooms or at night, and yet are unable to do any work during day-time, or see when the eyes are exposed to bright sunlight.

Anæsthesia Retinæ, or torpor of the retina, is a condition opposite to that just described in which vision is only possible in bright light. From observation and experiments which I have made in the provings of certain remedies, it seems to me to be dependent upon the defective innervation which lessens the rapidity of the secretions of the visual purple, inasmuch as the condition is rapidly improved by the internal administration of low attenuations of Jaborandi and Agaricus and the higher attenuations of Lycopodium and Hepar s. Among the causes which may be mentioned is exposure to bright lights, especially in anæmic patients. It is also not uncommon in sailors who are exposed to the bright sun of the tropics in long voyages when the night is bright as well as the day. There are certain cases, as those occurring in squint from non-use of the eyes, or concussion of the eye, or in senile degeneration of the retina, as well as those depending upon atrophic conditions of the optic nerve and retina, which are not benefited by remedial treatment.

Hemeralopia, or night blindness, is a term which is often applied to those cases occurring where the vision is better during the day-time than by dim or artificial light. In cases presenting these symptoms we should closely examine the retina for some indication of retinitis pigmentosa, of which it is a common symptom.

Commotio Retinæ is a term applied to sudden loss of vision occurring from concussion of the eyeball, after blows received upon the eyeball, or upon neighboring parts and also after a stroke of lightning. There are usually no ophthalmoscopic changes apparent, yet the blindness is often complete and permanent.

Hemiopia is loss of function of the lateral half of the retina, and usually affects the same side in both eyes. In this

condition there is loss of sight of the affected portion. Commonly there is absence of the right or left half of the object, as when the right or left sides of each retina are affected, when the condition has been termed homonymous hemiopia; if both the internal or external sides of the retina are blind the hemiopia is termed respectively temporal or nasal. In very rare cases the upper or lower half of the field may be wanting. These cases are due to causes which lie in the brain or in the optic tracts behind the commissure. Sometimes these affections are temporary, and due to some disturbances of the circulation. They are, however, commonly permanent, and associated with intra-cranial, syphilitic, tubercular or other diseased conditions of the brain, such as tumors. As a rule there is no change in the ophthalmoscopic appearances of the retina beyond a possible contraction of the arteries and hyperæmia of the disc.

Treatment.—The treatment must be directed to the discernible or probable cause. Certain of our remedies are useful in some of the cases and others, from their provings, give promise of value. When the upper half of the field of vision is defective, Aurum, Dig., and Gels. should be remembered, while for homonymous hemiopia, Calc. carb., Morph. sulph., Muriatic acid, Plumb., Sepia and Stramonium, and when the right half of the object is wanting Lith. carb. and Lycop. are to be considered.

SCOTOMA is a term which is applied to other less extensive disturbances of the fundus of the retina; when only a small portion of the retina is insensible to light, this portion appears to the patient as a black spot in the field of vision, and is then termed a *positive scotoma;* when it is only found by an examination of the visual field and not apparent to the patient, it is termed a *negative scotoma*; of the latter the absence of that portion of the field which corresponds to the optic disc is apparent in the normal visual field; if the macula is affected a *central scotoma* is present. Scotoma commonly occurs in diseases of the optic nerve.

Causes.—Scotoma may appear as the result of injuries,

diseases of the retina or hemorrhages, opacities of the vitreous, or diseases of the optic nerve or of the brain. It may also occur from exposure of the eye to bright sunlight, as in observing an eclipse of the sun through a telescope, or from exposure to a very brilliant flash of lightning. In many cases, however, there is purely functional loss without apparent tissue change.

Treatment.—No special treatment of the eye is advisable in these cases beyond that indicated for the condition upon which the scotoma depends.

Color Blindness is an impairment of the function of the retina with inability to discriminate colors, and is usually congenital; but it is also met with in an acquired form, in many diseases which affect the retina, optic nerve, brain or spinal cord. In the congenital form, which will be considered here, the patient's sight may in every respect be perfect, but he is unable to distinguish certain colors, as red, green or blue when there is partial color blindness, or there may be absolute color blindness, black and white alone being recognized. The most common form of color blindness is the partial, and occurs in about four per cent. of males to one per cent. of females, and is more frequent in the lower classes. Color blindness for red is the form most frequently presented. The faulty perception of the various shades of green are next in frequency, while the perception for blue or yellow is very rarely absent. The cause and pathology of color blindness is as yet unknown. The detection of color blindness is of the utmost importance and should be thoroughly understood, and of the numerous tests proposed, that of Holmgren, described in Chapter II, will afford the most satisfactory results.

The condition is not amenable to treatment except in the acquired form, which will be considered in speaking of diseases of the optic nerve.

TUMORS OF THE RETINA.

Glioma of the retina, which has its origin in the granular layers or arises from the connective tissue of the retina, is the

only kind of tumor occurring in this tissue. It consists of round cells and nuclei, imbedded in a small quantity of intercellular substance, and there is frequently a marked development of blood-vessels. As the growth increases and involves other portions of the eye, it partakes of the characteristics of sarcoma. It more commonly appears in one eye, but not infrequently affects both.

Causes.—Glioma arises almost exclusively in very young people, between the ages of one to twelve years, though it may appear as early as one month after birth, and would seem to be hereditary and dependent upon cancerous dyscrasia in the family. In extremely rare cases it may develop in older persons, when it first appears as a white patch in the retina. In general the causes are obscure.

Symptoms and Diagnosis.—The earliest symptom is a whitish, yellow, or bluish-white appearance of the pupil, which on examination is found to exist behind the lens, and the eye is devoid of vision. No pain or redness is present, and often the case is not brought for treatment until the eye becomes enlarged, or pain and congestion of the sclera occur. As the tumor grows it advances into the interior of the eyeball, producing atrophy and detachment of the retina as it proceeds. With the ophthalmoscope, it appears like detachment of the retina or inflammatory changes in the vitreous, which closely simulate it, and from which it must be distinguished by the absence of iritic adhesions, and from the history of the inflammation preceding the white or yellowish appearance of the pupil. The appearance of vessels upon the surface of the bulging mass, which do not correspond with those of the retina, will enable us to designate it from other affections. As the tumor increases in size the intra-ocular tension increases, and the pupil becomes dilated and the child complains of pain from the glaucomatous condition which occurs. Other portions of the tissues of the globe become involved with the increase of the tumor, and the lens loses its transparency, the cornea becomes opaque, and all semblance of the eyeball is lost in the protruding mass which extrudes between the lids,

and appears as a fleshy body, secreting a sanious discharge and subject to frequent hemorrhages in the advanced stage of the disease, when it is called *fungus hæmatodes* of the eye.

Prognosis.—When the disease is recognized in the early stages, while confined to the retina, the removal of the eyeball with a portion of the optic nerve, which on examination shows no sign of implication, is usually favorable. The case, however, is even then not safe until several months or a year have passed without indications of the return of the growth. In the majority of cases the removal of the eye is not acceded to, or the disease has progressed along the optic nerve so that the brain is oftentimes affected, or the contents of the orbit have become infiltrated with cancerous cells, so that death follows at an early date, from intra-cranial tumor or exhaustion due to the cancerous cachexia.

Treatment.—Immediate removal of the ball with as great a portion of the optic nerve as possible, is imperative when the tumor is confined to the interior of the eye. When it has extended beyond the confines of the globe the question of operative interference is a grave one, as often the complete extirpation of the contents of the orbit affords only temporary relief, the sarcomatous mass, under these circumstances, seeming to acquire fresh energy from the operative measures.

In extremely rare cases the growth is reported to have been checked and the eyeball become atrophied, but this is so unusual, and the general tendency of the disease so fatal, that time should not be lost in awaiting probable absorption. After the removal of the growth, it is my practice to place these patients upon carbolic acid 1x in water, three times a day for several months, and good results have occurred from its use.

CHAPTER XXI.

DISEASES OF THE OPTIC NERVE.

ANATOMY.

The optic nerve connects the retina, its ultimate expansion for the reception of visual impressions, with the brain centres where perception takes place. It may be divided for examination into three parts, the cranial, orbital and ocular portions.

The ultimate origin of the optic nerve has been determined to be in the grey matter near the gyrus angularis of the occipital lobes. Other points of origin have been found in the optic thalami, corpora quadrigemina, posterior columns of the spinal cord, corpora geniculata, crus cerebri, tuber cinerum, the lamina cinera, and the anterior perforated space. The filaments connecting these portions of the brain and spinal cord are brought together to form the optic tracts, one on each side, which pass forward beneath the thalami and curve around the crus cerebri, to unite upon the olivary process of the sphenoid bone to form the optic chiasm or commissure.

At the commissure a partial decussation of the fibres takes place, the outer fibres from the right optic tract passing direct to supply the right half of the retina of the right eye, the medial fibres passing to the more central portions of the retina while the inner portion goes to supply the inner half of the retina of the left eye. The fibres of the left tract are also

divided, the inner portion going to the inner half of the right eye, the medial fibres to central portions of the retina of the left eye and the outer portion passing direct to the outer portion of the retina of the left eye. At the commissure, fibres have also been described as connecting the two retinas and have been termed inter-retinal fibres; some intra-cranial fibres which pass directly from one side of the brain through the commissure to the other, without going to the eye, have also been found.

The orbital portion of the optic nerve leaves the chiasm and enters the foramen opticum, becoming rounded and firmer and consists of several hundred bundles of nerve fibres which are separated from each other by connective tissue. After passing through the foramen it emerges into the orbit where it curves slightly and passing forward enters the eyeball a little to the nasal side and slightly below its horizontal plane, and passes through the sieve-like membrane, the lamina cribrosa (*l* Fig. 150) in the opening in the sclera, to be distributed to the various portions of the retina. The orbital portion of the nerve possesses two sheaths, an external one (*e*) the prolongation of the dura mater, and an internal one (*i*) formed by a continuation of the pia mater; the space (*v*) between these sheaths which also contains a prolongation of the arachnoid, forms the inter-vaginal or sub-dural space which communicates directly

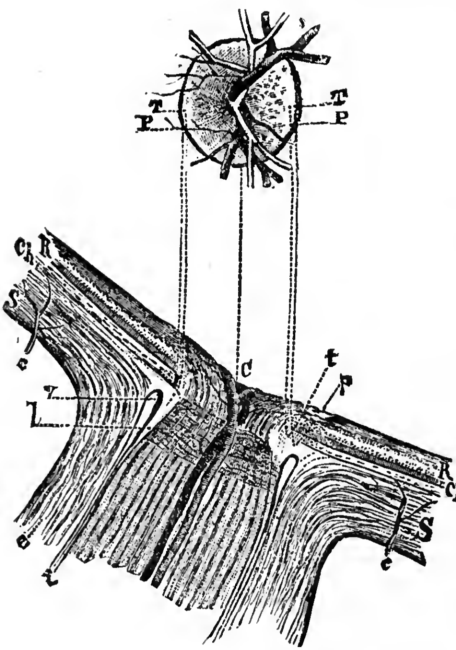


FIG. 150.

with the cranial cavity. In this portion of the nerve, for a distance of 15 to 25 mm. behind the eyeball, a central canal (c) is formed for the transmission of the central artery and vein.

The ocular portion of the nerve consists of that portion which enters the eyeball; the sheaths which have covered the orbital portion pass over and are continuous with the sclera, while the inter-vaginal space ends at this point, and the optic nerve fibres leave their medullary envelopes and pass through the lamina cribrosa, to emerge upon the interior of the eye, where they form a slight elevation circular in form and about 1.5 mm. in diameter, the optic disc or papilla. From the edge of the disc the nerve fibres curve gently to pass over into the retina to form its nerve-fibre layer.

The optic disc when examined by the ophthalmoscope presents a pinkish appearance which is generally deeper in color on the nasal side. The color is due to the blood in the capillaries, and as these blood-vessels diminish in number, as in atrophic conditions of the nerve, the disc becomes white. At the margin of the disc a black circle is distinguished, the *choroidal ring* (P Fig. 150). This ring may be entirely absent or appear as a crescent. Within this circle is discovered the *scleral ring* (T Fig. 150), white in color, and marking the limit of the pial sheath. In the centre of the disc where the central artery enters, a small funnel-like depression the *porus opticus* (c Fig. 150) is seen. When the nerve fibres begin to branch out into the retina at the lamina cribrosa and before reaching the surface of the papilla a more or less large hollow is observed in the disc; this constitutes the *physiological cup.* When this excavation is large it may be difficult to distinguish it from the cupping which occurs in glaucoma; it, however, never extends quite up to the scleral ring and does not present the displacement of the blood-vessels which are common to the pressure excavation. In these cases of cupping the translucent nerve fibres permit the lamina cribrosa to be seen and give to the optic disc a mottled appearance.

DISEASES OF THE OPTIC NERVE.

Any portion of the optic nerve, either in the cranium, in the orbit, or at its intra-ocular distribution may become diseased. The changes which occur may begin in the nerve itself, or extend from the other structures of the eyeball, from the orbital tissues, or from diseases of the brain, or more remote organs as those of the heart or kidney.

The pathological changes which follow are similar to those which occur in diseases of the retina or other nerve tissues. We may have *hyperæmia*, *inflammation*, or *atrophy*, of the optic nerve fibres. In the greater number of instances, the retina participates in the changes and the condition is one of neuro-retinal disease.

Any lesion of the nerve may lead to changes in its structure which prevent the transmission of visual impressions to the sensorium.

HYPERÆMIA.—Capillary congestion of the optic papilla is the common accompaniment of hyperæmic conditions of other portions of the interior structures of the eye. It may be indicative of cerebral congestion, inflammation or other morbid processes of the base of the brain. It is also symptomatic of certain anomalies of the refraction, as hyperopia and astigmatism, and of accommodative asthenopia and spasm of the ciliary muscle.

Diagnosis.—The optic papilla appears red, and new vessels are developed upon its surface and the edge of the disc, which before now were not noticeable. The margin of the disc becomes less distinct and ill-defined. The hyperæmia may be so marked as to make the disc appear of the same color as the fundus. The vision is not affected. The light may or may not be disagreeable.

Treatment.—This must be directed to the cause of the hyperæmia, as it is more frequently symptomatic than idiopathic. Such remedies as Bell., Duboisia, Nux vom. and Phosph. should be considered.

NEURITIS OPTICA.

Causes.—Inflammation of the optic nerve is, in general, symptomatic of some intra-cranial disease. It may arise idiopathically in depressed conditions of the system, as in syphilis and in patients suffering from various toxic influences as tobacco, alcohol and lead, or accompany affections of the spinal cord. It may also be the result of local or general disturbance of the circulation, anomalies of menstruation, and uterine, heart or kidney diseases. It may occur during typhoid fever or an attack of facial erysipelas. Again, injuries, orbital cellulitis, periostitis, or tumors in the orbit may be the exciting causes. The majority of cases, however, are traceable to various intra-cranial diseases, such as meningitis, inflammation, softening, or tumors of the brain.

Symptoms and Diagnosis.—Optic neuritis (Plate V, Fig. 3) can be recognized by the ophthalmoscope only. It may exist without diminution of vision, or the failure of sight may be sudden and complete. As a rule there is generally a gradual loss of vision which can not be accounted for by manifest changes in the superficial portions of the eye, and an ophthalmoscopic examination reveals the condition of the optic nerve. The disc appears more or less swollen, its surface hyperæmic, the lamina cribrosa is obscured, and the outlines of the disc are ill-defined, irregular and the optic nerve fibres are somewhat opaque from infiltration and give it the appearance known as "*wooly disc.*" The veins are dilated and tortuous while the arteries appear smaller than normal, and the vessels are covered here and there by the swollen tissue. In rare cases spontaneous arterial pulsation is observed. Striated hemorrhages upon the disc or in the retina are sometimes seen. White patches of sclerosis or fatty degeneration are not infrequently observed upon the disc or extending into the retina. Very often the retina is clouded by infiltration for some distance beyond the papilla. If the inflammation extends some distance into the retina the condition becomes one of neuro-retinitis.

Cases of neuritis in which there is great swelling of the optic disc, with hyperæmia and tortuosity of the retinal veins, but no extensive opacity of the retina constitute what is known as "*choked disc.*" This variety of neuritis, which was first described by Von Graefe, is dependent upon compression of the ocular portion of the nerve by fluid or inflammatory products which accumulate in the inter-vaginal space between the sheaths of the optic nerve. This space, enclosed by the tough dural sheath, is continuous through the optic foramen with the meningeal space in the cranium and is liable to distention through any increase of fluid within the meninges. Hence this form of neuritis is commonly associated with intra-cranial disease. The unyielding scleral ring in addition to the lamina cribrosa, prevents a dilatation of the opening for the entrance of the optic nerve, so that any compression of the nerve behind its entrance from fluid collected in the sheath, will proportionately retard the exit of venous blood. A slight œdema of the optic disc results which tends to retard the venous flow still more and thus increases the œdema. The process may continue until inflammation, degenerative changes and atrophy occur. The trunk of the nerve is believed to be healthy in the majority of these cases. Our knowledge of the changes in the optic nerve which produce neuritis optica and their relation to the various intra-cranial diseases which so often cause or accompany the inflammation, is as yet incomplete. Many of the cases which have been described as choked disc may be due to the extension of the inflammatory process along the nerve as in the so-called "descending neuritis." In *neuritis descendens*, a not uncommon form of inflammation which may or may not be associated with brain disease, the disc is congested and there is more or less infiltration of tissue of the papilla.

The pathological changes of the papilla in choked disc consist of the separation of the optic nerve fibre bundles by the infiltrating serum, and the appearance of varicose swellings upon the fibres. The veins become increased in number and calibre, and extravasations of blood may be found in and

upon the papilla. There is rarely any hypertrophy of the connective tissue elements of the nerve unless the condition has existed for a long time, when the nerve fibres will be found atrophied. In the other forms of neuritis which are marked by much greater inflammation, and interstitial changes, there is extensive infiltration of cells, increase of connective tissue and blood-vessels, which is followed by degenerative changes in the optic nerve fibres, or atrophy ensues.

Retro-bulbar neuritis is a variety of neuritis, also observed by Von Graefe, in which there is loss of vision associated with dilation of the pupil which is preceded by a slight congestion of the papilla and without inflammatory symptoms. Again there may be slight inflammation of the nerve observed which continues for a time and is followed by atrophy. Usually but one eye is affected. The loss of vision may be partial or complete and occur within a few hours or after a few days. There is generally no pain, except possibly a headache. There is usually central scotoma and loss of color perception. With the ophthalmoscope the disc may appear normal, or present some injection, swelling and infiltration. The seat of lesion is located by exclusion in the orbital portion of the nerve and may follow upon typhoid or malarial fevers, measles, menstrual disorders, rheumatism, syphilis, etc.

The changes which are observable in the various forms of neuritis are not always limited strictly to the disc as in a true papillitis, but in many cases there is more or less haziness and swelling of the retina which may extend some distance from the disc. In neuro-retinitis, hemorrhages, white or yellow dots or patches will be found in the disc and retina; these cases are generally presented in the advanced stage of Bright's disease or may be due to cerebral disease and albumen not be present in the urine.

Prognosis.—The prognosis as regards sight will depend upon the assumed cause, the length of time the inflammatory process has existed and the amount of tissue change which may be observed with the ophthalmoscope. The prognosis is generally unfavorable. The vision varies greatly during the

progress of the disease, and the ultimate effect upon the vision will depend upon the changes which occur in the nerve tissues. Resolution may take place and the vision be largely regained, or consecutive atrophy result with perhaps complete destruction of vision.

TREATMENT.—The treatment will depend somewhat upon the supposed cause of the affection. Rest of the eyes becomes necessary, all near work should be avoided and the eyes protected from the light by smoked glasses. It is not necessary to confine the patient to a darkened room, except in extreme cases or when the cerebral disease is such as would require close confinement. Proper hygienic regulations should be observed in all cases. The remedies which will likely be indicated will depend upon the exciting cause and the concomitant symptoms and are Bell., Duboisia, Phos., Puls., Nux vom., and Verat. vir.

OPTIC NERVE ATROPHY.

In atrophy of the optic nerve, we distinguish two forms, a primary and a secondary atrophy. In the primary form the process begins in the nerve, while the secondary variety is preceded by an inflammatory process.

The proper classification, however, would be that of parenchymatous and interstitial, as the pathological changes which occur can be definitely stated as due to sclerosis or fatty degeneration or atrophy of the parenchyma of the nerve fibres, on one hand, or result from increase of the interstitial connective tissue, which exists between the nerve fibre bundles and consequent compression and atrophy of the nerve cylinders.

CAUSES.—While atrophy is the natural result of neuritis, it may also arise from various causes which lie in the brain or spinal cord, or follow injuries of the globe or orbit. Acoholism, syphilis, and inflammatory diseases of the retina or choroid not unfrequently cause it. Among other causes which may be mentioned are, the toxic effects of lead and tobacco, and certain diseases as facial erysipelas, measles,

menstrual derangements, fevers, diabetes and sclerosis of the spinal cord. In some cases no determinable cause can be found.

SYMPTOMS AND DIAGNOSIS.—The visual function is impaired, objects appear foggy and there is perhaps over-sensitiveness to the light which is followed later by a desire for strong light. The pupils are either contracted or normal and sluggish. The field of vision becomes contracted and the color perception, impaired or lost. The power to distinguish green is first lost, then that for red, and finally for blue and yellow when the perception for color has entirely disappeared. In certain cases of atrophy due to alcohol or nicotine poisoning the first color which is lost is red, or there may be only a central scotoma for red.

The atrophy usually affects both eyes and is commonly associated with other nervous diseases, particularly of the spinal cord and due inquiry should be made into the mental and cerebral symptoms.

The ophthalmoscopic appearances of both the primary and secondary forms are somewhat varied. The optic disc is opaque and white, or bluish white, and the capillaries of the disc absent. In some cases the lamina cribrosa may be seen and appears as a mixture of white and dark dots in the central portion of the disc. The papilla appears flat, or concave and excavated, and the outline of the disc sharply defined if the atrophy is well advanced. In the early stages of the secondary atrophy the disc may present an irregular outline and perhaps patches of pigment will be observed around it as in Plate V, Fig. 5. The vessels are diminished in number and calibre, and sometimes almost entirely absent. In some cases of progressive atrophy, the retina also partakes of the atrophic process and becomes thinned, so that the choroidal vessels become very prominent as in Plate V, Fig. 6. In the primary form of atrophy the color of the disc is usually white or grey while secondary atrophy presents often a yellowish appearance which later is replaced by a white or greyish color.

TREATMENT.—The treatment consists of the improvement of the general health by promoting the general nutrition. All

stimulants and tobacco should be avoided. The remedies which will be useful in atrophy are Strychnia, Nux vomica, Argent. nit., Phosph., and Zinc. phos. Occasionally, when other remedies fail, hyperdermic injections of the sulphate of strychnia, will be found beneficial.

AMAUROSIS AND AMBLYOPIA.

Amaurosis is characterized by complete blindness with normal ophthalmoscopic appearances of the interior of the eye, as well as the absence of any external condition to account for the loss of vision.

Amblyopia is that condition, where there is partial loss of vision which is neither dependent upon any refractive error, nor upon any discoverable changes in the normal ophthalmoscopic appearances of the fundus.

Causes.—It is often congenital and often accompanies high degrees of hyperopia, myopia or astigmatism, and remains after the full correction of the ametropia. It is also present in strabismus, the squinting eye rapidly losing vision, the cause being supposed to be due to the fact that the eye does not participate in the visual act, and the condition has been termed *amblyopia ex anopsia.* Among other causes may be cited injuries to the globe, as blows upon the eye or orbit which cause concussion of the retina without any visible lesion of the eye. In these cases the pupil is rigidly contracted, and the vision is restored after a few days, or remains impaired. Injuries at the base of the skull not infrequently result in complete or partial loss of vision without perceptible changes in the eye. Concussions and injuries to the spine commonly produce loss of vision without ophthalmoscopic changes, and the amblyopia follows sometime after apparently complete recovery from the immediate effects of the injury, and is permanent. Extensive loss of blood in anæmic patients will sometimes occasion loss of vision which may be partial or complete and appear immediately upon the hemorrhage or not until some days afterward. Uræmia, from diseases of the

kidney, as in Bright's disease, and as found in diabetes frequently produces amblyopia which may be temporary or permanent and followed by atrophy of the nerve. It also arises from poisoning by various drugs, as lead, quinine, salicylic acid, aniline pigments, as well as silver and mercury. Derangements of the nervous system, such as hysteria (*amblyopia hysterica*), paresis, and spasmodic affections are causative. Again it may arise without apparent derangement of the health.

Sexual excesses and the use of tobacco (*amblyopia nicotina*) and alcoholic stimulants (*amblyopia potatorum*), either singly or together produce amblyopia. In the amblyopia of tobacco and alcohol both eyes are affected and the condition may arise from either cause, and while the use of both are commonly combined in the same individual, yet undoubted cases occur in which the effect is produced by one or the other.

Chronic alcoholism has long been recognized as productive of loss of vision and of optic nerve atrophy. The ophthalmoscopic appearances are usually a dull red disc with perhaps a hazy border and a torpid circulation of the fundus as evinced by the swollen veins. There is often an anæsthetic condition of the retina and later contraction of the visual field, and impairment of color perception.

Tobacco poisoning exhibits still fewer ophthalmoscopic lesions, the nerve is more nearly normal, brighter in color, and later shows signs of inflammation or interstitial atrophy. The vision is often much reduced but there is rarely any contraction of the field of vision. There is very frequently a central scotoma for red, which has been considered diagnostic. The central vision may remain good for light and form in these cases, but there is inability to distinguish red tints in this portion of the field. In either of these two forms of amblyopia the loss of vision may come on insidiously and without headache or other symptoms. Inquiry in the majority of cases will however reveal the fact that the stomach has become deranged and that there is nausea and rejection of food particularly in the morning.

Treatment.—The treatment of amblyopia is dependent entirely upon the cause, which is to be removed. When dependent upon injuries and general diseased conditions these demand immediate treatment and the amblyopia may disappear with the relief of the primary symptoms, or if persistent requires such medical treatment as may be indicated by the cause or concomitant symptoms. When excesses in venery, tobacco or alcohol, give rise to the condition, absolute abstinence is demanded, and if the disc is normal and the field not limited, the abandonment of all indulgence, together with the use of such remedies as Strych., Nux vom., Arsenicum and Phosph. will result in complete recovery.

Simulated Blindness.—Loss of vision is sometimes feigned for the purpose of escaping the performance of duty, to excite sympathy, or to recover damages for slight injuries. If the amaurosis is claimed to affect both eyes, it becomes a difficult matter to determine the malingering when the ophthalmoscopic appearances are normal. In the amaurosis of both eyes, which occurs from other causes than uræmia, the pupils are somewhat dilated and immovable, but the dilatation is not as great as that which follows the instillation of atropine. If the blindness is pretended it may be detected by any variation in the action of the iris under the influence of alternate light and darkness, or by bringing an instrument suddenly from above directly in front of the eye when a natural closure of the lids occurs to prevent impending injury to the eye when vision exists.

When the imposition exists for only one eye, it is more easily determined. In this case if a prism of ten or fifteen degrees is placed before the healthy eye, with the base either up or down, and if the patient sees the dot on the line double as in the insufficiency of the recti muscles in asthenopia, the imposition becomes apparent at once. Other tests may be made with the stereoscope, the slides being so arranged that the picture before the healthy eye is darkened, while that before the supposed blind eye is clear, or a cross may be placed on the slide before one eye while a circle is fixed before

the other; where there is binocular vision the patient sees a cross within the circle.

In all cases great care must be exercised to prevent the patient from suspecting that the methods employed are to discover the dissembling, and he should be given to understand that the desire is only to determine the cause of the amaurosis.

Tumors of the optic nerve are very rare and may be neuromata, carcinomata, or cystic, and may develop in the cranial or orbital portions of the nerve. There is usually a marked neuro-retinitis during the development of the tumor, or an exopthalmus when the growth involves the orbital portion—when the tumors are within the orbit an operation is indicated and enucleation or extirpation of the contents of the orbit will become necessary. Glioma may arise in either the retina or optic nerve, and when developing within the globe frequently extends backward to the brain when unchecked by early removal.

INDEX.

To relieve or prevent Asthenopia.

1) Cease to use eyes for time being & look away fm work when sight becomes painful blurred or indistinct.
After perfect rest for a moment work may be resumed to be discontinued as before when eyes feel fatigued.

2) Never sit facing light. Should fall upon work fm above & behind left shoulder. A flickering light is injurious.

3) Never read on cars. This dangerous practice is a frequent cause of weakness of sight.

4) Never read while lying down, it is too fatiguing for accomodative power.

5) Do not read much during convalescence fm illness
General health maintained by diet, sleep, air & exercise.
Take plenty of sleep. Ten hrs sleep for delicate eyes is better than